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Vol. 21 **No. 2**

JUNE, 1955

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ARTICLES

ANIMAL ECOLOGY

A NEW DEVELOPMENT IN THE UNIVERSITY OF ADELAIDE

By H. G. ANDREWARTHA

A unit of animal ecology has been established in the University of Adelaide, Zoology Department. This will enable the Department to offer a good course of training in animal ecology to students both at the under-graduate and the post-graduate levels; and we hope to build up a strong school for post-graduate research in this subject. This development has been made possible, in the first instance, by generous gifts of money to the University by the C.S.I.R.O., the Commonwealth Bank Rural Credits Fund and a number of public-spirited citizens of Adelaide. Thanks to this generous support the salaries of a reader and a senior lecturer are assured initially for a period of five years and we have been able to spend £5,000 on equipment. As a result the unit has been able to get away to a good start, supplied from the beginning with most of the basic equipment that it needs.

"Ecology" is a familiar word and most readers of this Journal may consider that they know its meaning. But I doubt whether many, if pressed, could tell a precise meaning for it. This is because biologists have, unfortunately, had a tendency to treat "ecology" as a dumping ground for odds and ends of knowledge that don't fit elsewhere. Also there has been rather a lot of muddled thinking and writing in this field so that the meaning of "ecology" has become attenuated. Compared to the precise meanings which can be attributed to such words as "genetics" or "entomology," the meaning of "ecology" seems rather nebulous.

To me animal ecology means the scientific study of populations of animals living more or less naturally. It consists, essentially, of getting to know how the various components in the environment of an animal may influence its chance to survive and multiply. We seek this knowledge so that we may explain the distribution and abundance of animals in nature. The particular questions that we ask take the form : why is a certain sort of animal usually found in certain areas (or regions) and not in others ? Why are they numerous in one place but scarce in another ? Why are they more numerous this year than they were last? And so on.

I am using "animal" in its broad zoological meaning. The principles of animal ecology are relevant to the populations of all sorts of animals whether they be the useful domesticated kind or harmful pests like the rabbit or the locust. We may also study some that are neither harmful nor useful if they happen to be good experimental subjects. But, for a variety of fairly obvious reasons, the animals that are of economic importance very often turn out to be the most convenient ones to work with.

A topical example of the practical benefits that may arise from research in animal ecology was provided this year in South Australia by the timely forecasting of an outbreak of the apple thrips, *Thrips imaginis*. These are very small insects; I have counted as many as 850 in one small rose. They are also strongly

H. G. ANDREWARTHA, M.Agr. Sc., D.Sc., has recently been appointed to the newly-established post of Reader in Animal Ecology in the Zoology Department in the University of Adelaide.

attracted to the blossom of apples. When they are numerous (say more than 20 in a flower), they destroy the essential organs, stamens and pistil, and prevent fertilization. *Thrips imaginis* were very numerous this year at the time when the apples were in flower. Many growers were able to protect their crops by spraying at the right time with the appropriate insecticide because they had been warned well in advance to be prepared for a plague of thrips this year. If this warning had not been given growers would have been caught unprepared, and the destruction of the blossom by the thrips might well have resulted in the loss of many thousands of bushels of apples—as was the case after the disastrous outbreak of *Thrips imaginis* in 1931.

The warning was issued by the Department of Agriculture in collaboration with the University of Adelaide, Waite Institute. But the knowledge which made this forecast possible arose from prolonged and thorough study of the ecology of the apple thrips by a team of workers under the general direction of the late Professor Davidson. The money for this investigation was largely raised by subscription among apple growers who had experienced the great plague of thrips that occurred in 1931. The C.S.I.R.O. and the Waite Institute co-operated to carry the project through.

The striking practical success which attended this investigation may have been partly due to the fact that the ecology of *Thrips imaginis* is simpler than that of many other animals. This is another way of saying that *Thrips imaginis* lives in a relatively simple environment. That was why we were able to get to understand it so well.

The environment of any animal (even that of *Thrips imaginis*) is too complex to be studied as a whole. So the ecologist always analyses the complex environment into simpler components and then attempts to find out how each component may influence the animal's chance to survive and multiply. The environment of any animal may be completely described in terms of four major components, namely, weather, food, other animals and a place in which to live. Each major component may be sub-divided into still simpler components; and, in particular cases, it may be instructive to carry the sub-division of different components to different degrees.

In the case of *Thrips imaginis* we found that only two components are limiting, namely, weather and food; and we were able to concentrate our attention on them. The weather in the spring and also in the preceding autumn determines the abundance of food for the thrips in the spring and also has a direct influence on the multiplication of the thrips themselves. This simplified the problem considerably and enabled us to get a good correlation between the numbers of thrips that we counted in the flowers and the records of rainfall and temperature. And we were able to tell with precision and a considerable degree of certainty just what components of the weather were influential in determining the numbers of thrips that were present during the spring (Davidson and Andrewartha, 1948a, 1948b).

With other animals whose ecology is more complicated we might not expect such striking success. But there is scope in Australia for a lot of research in that sort of ecology in which our unit will specialise. In Australia we know only too well the propensities of many of our insects, rodents, marsupials and other sorts of animals to multiply to plague numbers from time to time. From my experience in South Australia I can remember spectacular plagues of rabbits and mice among the rodents, kangaroos and opossums among the marsupials, and locusts, thrips, grasshoppers, grassgrubs, Rutherglen bugs and many others among the insects.

So, it is natural, in Australia, when we think of the practical side of animal ecology to think first of the pests. But in other parts of the world a lot of work has been done on the ecology of useful animals; and this has a practical outcome

in improved methods for the conservation of wildlife.

For example, the muskrat is a small rodent which is much prized for its fur and which is extensively hunted and trapped in North America. The muskrat leads a semi-aquatic life. They are well suited by an expanse of shallow water in which the level does not fluctuate much. Marshes are good; and streams are also good, especially the sort that resemble marshes. In these sorts of places the muskrats can make burrows which open under water but have their main galleries above water level under the surface of ground near the bank of the marsh or stream. In these burrows the muskrats may live securely protected from their predators. Fluctuations in the water level may be harmful; floods may drive the muskrats out of their burrows, and drought may leave their burrows exposed to predators.

Temporary changes in the numbers of muskrats that may live in an area may therefore be brought about by fluctuations in weather, especially in rainfall. Changes of a more permanent kind have resulted from the artificial draining, ditching or damming of marshes and streams. Dymond (1947) referred to work of this kind which was done in the delta of the Saskatchewan River, Manitoba. Water was diverted into dried up marshland and this greatly increased the number of suitable places for muskrats to live in. The number of muskrats in the area increased from 1,000 to 200,000 in the course of four years, with a consequential gain to the fur trade.

In Australia we may have less scope for work of this kind than in many countries of the Northern Hemisphere. But I am confident that, as we increase the numbers of biologists who have had a sound training in the principles of ecology, the opportunities for good work in the conservation of wildlife will become increasingly apparent.

There is not the opportunity, in this short article, to describe any other examples of the ecologist's art. Those who are interested may read about many others in "The Distribution and Abundance of Animals" (Andrewartha and Birch, 1954). In order to convey to you briefly the scope of the subject I have drawn up the following list of projects in which the ecologist may properly be interested—or, alternatively, biologists working in these fields, without being fully qualified ecologists, might, nevertheless, be the better for having had a grounding in the principles of ecology during their early training.

1. Ecology of harmful agents—
   (a) Animal parasites, e.g., cattle and dog ticks and other arthropods, larval stages of round worm parasites of sheep and cattle, nematode parasites of plants.
   (b) Pests of stored products, e.g., grain weevils, etc.
   (c) Pests of pastures, e.g., rabbits, kangaroos, emus, grasshoppers, etc.
   (d) Pests of orchards, eg., scale insects, etc.
   (e) Forest pests, e.g., rabbits and insects.
   (f) Vectors of parasites and reservoir hosts, e.g., snail vectors of liver fluke, foxes, etc.
2. Effects of economic poisons on ecology of harmful and useful species, e.g., large scale DDT spraying.
3. Effect of bush fires on the ecology of useful and harmful species.
4. Role of natural fauna in the maintenance of soil fertility and structure.
5. Ecology of agents concerned in biological control measures.
6. Ecology of useful species.
   (a) Insects concerned in pollination.
   (b) Predators or harmful species, e.g., certain Hymenoptera.
   (c) Ecology and animal husbandry. The maintenance of flocks and herds in the most economical way is largely a problem in the

management of populations and as such is primarily a problem in ecology.

(d) Marine and freshwater animals used for food or for industrial purposes.

(e) Naturally-occurring and introduced animals of economic importance, e.g., mutton birds.

To sum up. In addition to teaching under-graduates and maintaining a school for post-graduate students we would like our unit in animal ecology to undertake long-term research into the fundamental aspects of ecology. For example, there is need for a good fundamental study of dispersal in relation to the distribution and abundance of animals. The role of predators in nature is another subject on which it is still very difficult to generalise. Another field in which fundamental knowledge is required is the way in which small terrestrial animals are able to survive in dry places, especially during droughts. This is a problem that is especially relevant to ecology in Australia.

There is an essential core of ecology in most problems relating to the control of pests—insects, rodents, birds, etc.; in this case the goal is to find ways to reduce the numbers in the populations. The management of fisheries, flocks and herds and the conservation of game depend on ecology; in this case the objective is to maintain the population at a relatively high level. Many problems in parasitology also depend on ecology. Unless the investigator has a good grounding in the principles which govern the growth and decline of natural populations, he is likely to be working in the dark. There is room in all these fields for men who have taken their post-graduate degrees in ecology and have specialised in this subject.

But the usefulness of ecological teaching in the University goes more deeply than this. The work of specialists in other disciplines (physiology, pathology, genetics, etc.) is ultimately justified on the grounds that it enables us to have larger populations of sheep or cattle or smaller populations of rabbits or locusts, or on similar grounds which lead back to the consideration of the numbers which make up populations of animals of one sort or another. For this reason biologists who do not intend to specialize in ecology should also be trained at least in the elementary principles of ecology while they are under-graduates. If they have this training they are more likely to learn, in later years, to discriminate between the more and the less important questions that need answering in their own fields of work. Also in a world where the prosperity of nations and perhaps peace or war may depend on the way that the nations regulate the densities of their populations relative to their resources, ecology may be regarded as an essential part of a liberal education.

References

Andrewartha, H. G. and Birch, L. C. (1954)—"The Distribution and Abundance of Animals." University of Chicago Press.

Davidson, J. and Andrewartha, H. G. (1948a)——Annual trends in a natural population of *Thrips imaginis* (Thysanoptera). *J. Anim. Ecol.* 17 : 193-9.

Davidson, J. and Andrewartha, H. G. (1948b)—The influence of rainfall, evaporation and atmospheric temperature on fluctuations in the size of a natural population of *Thrips imaginis* (Thysanoptera). *J. Anim. Ecol.* 17 : 200-22.

Dymond, J. R. (1947)—Fluctuations in animal populations with special reference to those of Canada. *Tr. Roy. Soc. Canada.* 41 : 1-34.

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THE PROTEIN CONTENT OF SOME AUSTRALIAN WHEAT VARIETIES

By A. J. MILLINGTON

Hardness and protein percentage are still regarded, particularly by traders, as reliable means of assessing the baking quality of a grain sample. Whilst the three characters are related, neither hardness nor a high protein content is necessarily a guarantee, except for specific varieties, of a satisfactory flour "strength" for baking purposes. Their relationships for a number of Australian varieties have been reviewed by Breakwell and Hutton (1939) and Millington and Remilton (1954). The latter authors have suggested that to raise substantially the baking quality of southern Australian wheat it will be necessary to increase the protein content and to cultivate inherently strong varieties which will use efficiently the increment in nitrogen content. The prospects of increasing the protein content by cultivating varieties which tend to have a higher percentage of nitrogen at the present levels of soil fertility were also discussed. It was reported that an examination of data from Queensland, South Australia and Western Australia showed that on the average for each of the regions examined the amount of protein produced per acre appeared to be relatively constant for all the important commercial varieties. It was concluded therefore that unless soil fertility was greatly improved a substantial increase in the protein content of the cultivated varieties was likely to be associated with a lowering of the grain yield per acre.

The data used in the above study were not collected for the specific purpose of an investigation of protein per acre and for this reason it was decided, with the cooperation of the Departments of Agriculture of Queensland, South Australia and Western Australia and the University of Sydney, to examine grain from their 1953-4 yield trials. A representative sample was taken from each plot of these trials and chemically analysed so that nitrogen per acre as well as yield from each trial could be submitted to statistical analysis.

Queensland Data

Chemical analyses were made on the grain from seven trials conducted by the Queensland Department of Agriculture, see Table I. As the varieties Gabo, Spica and Charter are of comparable maturity and were sown in six of the seven trials, their relative performance is given in Table II.

In five of the six trials the protein content was significantly different between varieties but the ranking was not consistent. In the two trials where yield differences occurred the variety Charter which had a significantly higher protein content gave a lower yield per acre. Consequently the yield of protein per acre of the three varieties was similar in these trials. This supports the suggestion that, even when grain protein levels are high, protein per acre tends to be relatively constant.

South Australian Data

The grain from seven trials in South Australia was analysed, see Table III. Data for the very early maturing varieties Insignia 49, Dirk 48, and Gabo can be compared in six of these trials. In all six trials Insignia 49 significantly out-

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TABLE I.

Summary of Queensland data from yield trials of various wheat varieties at different experimental sites.

EXPERIMENTAL SITE	GATTON			BOYNESIDE*			EDENVALE			BOYNESIDE†			HARRISVALE			BILOELA			HERMITAGE		
Wheat Variety	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac	Bus/ ac.	% pro- tein	lb. N/ac.
Gabo	62.7	10.54	69.9	12.6	12.48	16.6	9.5	15.10	14.9				41.6	11.63	51.1	23.1	13.85	33.7	44.5	14.59	66.0
Charter	60.2	10.66	65.3	13.8	13.22	19.3	12.8	15.39	20.8				36.6	12.54	48.5	24.4	13.22	34.9	39.2	15.56	64.2
Spica	58.5	11.11	68.2	13.4	13.57	19.1	11.2	16.24	19.4				40.5	11.34	48.3	22.6	16.02	38.2	43.8	14.99	68.9
K2P4 4620	65.5	10.83	73.4	12.4	13.57	17.7	10.5	16.07	17.0							22.1	15.16	35.4			
KGPF 4521	62.5	11.17	73.0	12.6	13.34	17.7	11.7	15.50	19.2							24.6	14.88	39.2			
Celebration	57.2	11.80	71.0							9.7	12.77	13.2	35.0	12.54	46.2				43.3	16.13	73.8
Festival	57.0	12.88	77.5													22.1	14.99	34.9	39.2	13.62	64.2
Lawrence	54.2	12.08	68.8							11.0	12.88	14.7	34.0	13.91	49.7	19.0	15.39	30.9	37.2	16.42	64.3
Puseas				12.2	12.48	16.1	10.9	14.71	17.5										38.6	14.53	59.3
Puora				11.9	13.00	16.4	10.3	14.65	15.9				42.5	11.57	51.7	16.7	14.88	26.3	39.7	13.79	57.6
Puno				11.0	13.51	15.7	11.2	14.53	17.9				41.1	16.53	49.3	24.3	13.22	33.8			
Seafoam				8.6	15.22	14.0	8.8	15.39	14.1				44.3	11.97	55.9	15.8	14.48	24.3	40.6	15.33	65.6
Ford										11.5	12.65	15.3	18.8	12.08	23.9						
CHF Cur. 4604										11.7	12.71	15.7									
K2 Wpt. 4606										9.8	12.71	13.1									
Warput										9.7	11.29	11.6									
Kendee													32.3	11.40	37.0						
Saga																22.0	15.96	37.2			
Pusa 4																18.7	15.05	29.4			
Fedweb 5																			45.2	15.90	74.6
Difference for significance (P = .05)	N.S.	1.08	N.S.	2.4	0.51	N.S.	N.S.	0.85	N.S	N.S.	N.S.	N.S.	3.0	0.91	5.01	2.0	1.25	2.83	2.5	0.51	5.41

*Early and Midseason Wheats. †Late Maturing Wheats. N.S. indicates Not Significant.

TABLE II.

A comparison of the relationship of yield and protein content of the varieties Gabo, Charter and Spica.

Location	Grain Yield/acre	Protein %	Pounds nitrogen/acre
Gatton	Not significant	Not significant	Not significant
Boyneside	Not significant	Charter and Spica > Gabo	Not significant
Edenvale	Not significant	Spica > Gabo and Charter	Not significant
Harrisville	Gabo and Spica > Charter	Charter > Gabo and Spica	Not significant
Biloela	Not significant	Spica > Gabo and Charter	Spica > Gabo and Charter
Hermitage	Gabo and Spica > Charter	Charter > Spica and Gabo	Not significant

yielded Gabo while at all locations but one the protein content of Gabo was significantly greater. In three trials the protein per acre of Insignia 49 was significantly higher but in the others the differences were not significant.

These data supplement the information on Gabo and Insignia 49 for the seasons 1950-51 and 1951-52 and in all twenty comparisons are available. The mean yields in these three seasons were Insignia 49, 29.3 bus/ac and Gabo 24.9 bus/ac while the protein contents were 8.87 per cent. and 9.92 per cent. respectively. These differences are highly significant statistically but there was no difference between the yield of protein per acre of the two varieties.

It is notable however that in the two locations where Dirk 48 significantly outyielded Gabo its protein content was lower. In one the difference was significant and in the other substantial. At Minnipa where Gabo outyielded Dirk 48 their protein contents were similar. In only one trial was the yield of protein per acre of these two varieties significantly different.

The protein content of Scimitar 48 was significantly lower than that of Gabo in each of five trials but in only one was the yield of protein per acre different.

Four comparisons can be made of the mid-season varieties Sabre, Javelin 48 and Bencubbin 48. In each trial Sabre contained more protein than Javelin 48 and in two trials more than Bencubbin 48. In one instance Bencubbin 48 was superior to Sabre.

Javelin 48 and Bencubbin significantly outyielded Sabre at Urania but in only one of the twelve comparisons between these varieties was the yield of protein per acre significantly different.

Western Australian Data

The data for the 1953-4 season for Western Australia are given in Table IV. These trials were all conducted on Research Stations and at three of these, Chapman, Avondale and Wongan Hills, the sites had been under subterranean clover for three or more years prior to the cropping year. At three of the Stations Gabo yielded significantly less and at one site significantly more than Insignia 49. At all but one Station Gabo contained more protein.

The variety Bencubbin was tested against Festival in five trials and out-

TABLE III.

Summary of South Australian data from yield trials of various wheat varieties at different experimental sites.

EXPERIMENTAL SITE	URANIA (Fallow)			URANIA (Grassland)			BOOLEROO CENTRE			RUDALL			GEORGETOWN			MINNIPA			PASKEVILLE		
Wheat Variety	Bus/ ac.	% pro- tein	lb. N/ac	Bus/ ac.	% pro- tein	lb. N/ac	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac	Bus/ ac.	% pro- tein	lb. N/ac	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.
Insignia 49	35.6	10.89	40.7	19.5	10.60	21.8	46.9	7.98	43.3	19.2	7.41	15.0	59.1	10.26	65.4	25.7	10.49	28.3	37.6	8.83	34.9
Glenwari	29.3	11.51	35.2	18.6	11.23	22.1	42.1	9.01	39.9							22.7	10.43	25.0	33.4	9.29	32.7
Dirk 48	28.8	12.31	37.2	19.0	11.57	23.2	36.3	9.12	34.9	16.1	8.44	14.3	59.2	11.97	75.2	21.6	11.11	25.2	36.3	9.69	37.1
Warigo	28.4	11.80	35.3	14.3	11.63	17.4	39.1	9.06	37.2	14.3	7.69	11.6	57.8	11.29	69.4				31.8	9.80	32.8
Scimitar 48	28.3	11.46	35 2	20.8	11.29	24.7	40.2	8.78	37.3	16.5	7.64	13.3							37.1	9.35	36.7
Javelin 48	28.0	11.46	33.2	15.9	11.00	18.4	38.7	8.38	34.2	14.5	7.52	11.5	49.7	11.17	58.7				38.2	9.69	39.1
Gabo	26.8	12.08	34.0	13.1	11.91	16.5	38.0	9.40	35.1	15.3	8.38	13.5				23.5	11.11	27.5	32.4	10.37	35.4
Bencubbin 48	25.9	11.91	32.4	15.9	11.57	19.3	36.5	9.46	36.3	14.5	7.64	11.7	49.7	11.63	61.3				32.5	9.75	33.5
Sabre	22.3	13.22	30.6	14.4	12.77	19.4	39.4	8.89	37.1				53.4	11.91	67.7	24.0	11.17	28.2			
Bungulla							40.6	8.66	37.3				59.0	11.00	68.9						
Waratah							37.3	9.63	37.9	16.9	7.75	13.8									
Marathon										16.9	7.35	13.1									
Rapier 48										17.0	8.09	14.5									
Panther													52.8	11.74	65.5						
Sword													52.1	12.14	67.2						
Dundee 48													52.0	11.91	65.6						
RAC 154																25.4	11.40	30.5			
RAC 20																					
RDRx3 Jav. 48																24.9	10.49	27.6			
Bencubbin																24.8	11.00	28.7			
Brolga																					
RDRx2 Jav. 48																24.6	10.94	28.4			
Gluyas																21.6	11.06	25.1			
Curlew																					
Gabo 4																22.0	12.54	29.0			
Festival																			33.8	10.09	35.9
Ridley 48																					
Difference for significance (P = .05)	2.6	0.46	3.59	3 6	0.46	4.47	3 7	0.46	N.S.	1.3	0.34	1.48	5.8	0.57	8.42	0.5	0.74	3.0	2.2	0.57	3.40

N.S. indicates Not Significant.

yielded it in three instances. The protein percentage of Festival was significantly greater in each, but the protein per acre was significantly greater in only two of the trials.

In three of the five trials Bencubbin outyielded Bencubbin 48 but in two of these the protein percentage of the latter was significantly higher. The yield of protein per acre was similar for these varieties in all trials.

Grain was analysed also from the 1954-5 trials at the Chapman Research Station. The season was drier and this is reflected in the lower grain yields and higher protein percentages given in Table V. Of the very early varieties Gabo significantly outyielded Insignia 49 but contained significantly less protein. The yield of protein per acre of Gabo was significantly higher than that of Insignia 49. These results are a reversal of those obtained in the 1953-4 season.

Of the midseason varieties Festival again contained the greatest amount of protein and although it yielded less than Bencubbin the difference was not significant. The yield of protein per acre of Festival was significantly greater.

Environment and Grain Protein

The combination of high levels of yield and protein in one variety has been the objective of wheatbreeders for sixty years. However, in order to obtain high protein wheat in Canada it has been found necessary to restrict the farmer to certain varieties whilst in New Zealand a premium is paid to encourage the cultivation of the variety Hilgendorf. In Queensland and northern New South Wales high protein samples of inherently strong varieties are usual but in southern Australia premiums are frequently paid to encourage the production of this type of wheat.

The relationship of protein and grain yield was reviewed by Neatby and McCalla (1938). More recently Grant and McCalla (1949) used the unselected progeny from a cross between two white grained soft wheats, Bunyip and Dicklow, to confirm "the general negative relationship between yield and protein content". Working in Canada on fertile black loam at Edmonton each increment of 1 per cent. in protein content was associated on the average over a three-year

TABLE V.

Chapman Research Station Yield Trials, 1954-5.

Variety	Yield Bus/ac.	% Protein	lbs./ nitrogen/ ac.
(i) Very Early Varieties.			
Insignia 49	15.3	15.1	24.3
Wongoondy	18.0	14.7	28.0
Bungulla	16.8	14.0	24.8
M.115	15.9	15.4	26.2
Gabo	17.4	14.4	26.4
Difference for significance (P = .05)	1.3	0.5	1.8
(ii) Early Midseason Varieties.			
M.109	14.7	15.2	23.6
Eureka II	15.3	14.9	24.2
Bencubbin	15.3	15.2	24.3
M.114	13.0	16.0	21.9
Gabo	18.9	14.7	29.4
Difference for significance (P = .05)	1.0	0.3	1.6
(iii) Midseason Varieties.			
Javelin 48	11.2	14.9	17.7
Eureka II	11.9	14.6	18.4
Kondut	10.9	15.0	17.3
Bencubbin 48	10.4	14.2	15.6
Bencubbin	12.2	13.9	17.9
Festival	11.4	16.2	19.6
Sabre	11.5	14.6	17.8
Difference for significance (P = .05)	0.9	0.5	1.5

period with a loss in yield of 10.6 bus/ac. At Fallis on low nitrogen podsolic soil the loss was 8.3 bus/ac. While Grant and McCalla agree with Berg (1941) that "it should be possible to raise the protein content of high yielding strains, the extent to which this can be done is probably not great".

In the opinion of Grant and McCalla it is unlikely that there are specific genes for "high" or "low" protein but "it seems certain that the physiological factors that determine yield and protein content are genetically controlled". Extensive chemical investigations (Mecham

TABLE IV.

Summary of Western Australian data from yield trials of various wheat varieties at different experimental sites.

EXPERIMENTAL SITE	CHAPMAN			AVONDALE			MERREDIN			WONGAN HILLS			SALMON GUMS			ESPERANCE		
Wheat Variety	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.	Bus/ ac.	% pro- tein	lb. N/ac.
Very Early Varieties—																		
Insignia 49 ..	33.0	9.8	34	31.8	9.6	32	8.7	10.9	10.0	27.7	9.3	27.2	22.3	7.7	18.0			
Bungulla ..	25.9	9.4	26	29.8	9.5	30	6.5	10.6	7.3	23.7	9.3	23.2	17.7	8.0	15.0			
Wongoondy .	23.8	9.6	24	31.5	10.1	33	9.7	11.4	11.7	22.2	10.5	24.9	19.7	8.0	16.6			
Gabo	27.8	10.2	30	33.3	10.9	38	7.1	12.0	9.0	28.0	10.6	31.5	19.6	8.3	17.4			
Difference for significance (P = .05) ..	2.3	N.S.	2.9	0.9	0.4	1.6	1.6	0.7	1.7	2.0	0.3	2.1	1.3	0.3	1.4			
Early Mid-season Varieties—																		
Bencubbin ..	34.9	9.6	35				14.0	12.1	17.9	33.5	8.7	31	17.0	7.2	13.0			
M.107	32.8	11.4	39				14.9	13.9	21.8	32.5	10.5	36	15.6	8.3	13.8			
Dowerin	22.1	11.5	26				16.3	13.8	23.8	31.0	10.0	33	15.6	8.6	14.3			
M.109	31.0	10.8	35				15.3	12.6	20.3	32.5	10.3	35	17.5	7.9	14.9			
Eureka II ..	29.6	11.0	34				12.1	12.8	16.4	33.0	10.3	36	16.7	8.0	14.1			
Difference for significance (P = .05) ..	1.8	0.8	2.7				N.S.	1.2	N.S.	N.S.	0.7	2.1	1.1	0.6	N.S.			
Midseason Varieties—																		
Festival	30.5	11.8	34	25.1	11.7	31	18.1	15.2	29				16.1	9.1	15.5	11.8	9.0	11.4
Bencubbin 48	29.5	10.0	30	21.9	10.2	23	19.3	13.2	27				16.5	7.5	12.9	14.8	7.3	11.4
M.112	27.6	11.4	30	24.3	11.4	26	21.1	13.8	31				16.9	7.5	13.4	13.6	7.7	11.1
Bencubbin ..	32.7	10.0	31	23.3	10.0	23	23.6	12.2	30				18.6	6.8	13.7	15.6	6.5	10.6
Javelin 48 ..	31.3	10.7	31	28.8	9.6	29	25.7	12.3	34				18.5	6.8	13.3	15.4	7.3	12.0
Difference for significance (P = .05) ..	N.S.	0.3	N.S.	1.0	0.6	1.4	1.7	0.6	3.1				1.0	0.3	1.0	1.0	0.8	1.4

N.S. indicates Not Significant.

and Brother, 1950-1951) suggest that the nature of the proteins in bread and macaroni wheats is remarkably constant and no variations in their amino acid content can be detected regardless of their baking characteristics. Grant and McCalla (*op. cit.*) conclude that "the high yielding strains nearly always absorb more total nitrogen than do low yielding strains but the percentage of protein in such strains is consistently lower".

Extensive investigations by Waring (1951-54) on Queensland farms during the seasons 1951-52, 1952-53 and 1953-54 have shown that there tends to be an association between seasonal rainfall and grain protein. In the wet season 1952-53 the grain protein was much lower than in the other two years. Waring has shown, moreover, that substantial residues of "available nitrogen" may be present in the soil at harvest time on the Darling Downs, even on sites where there was an obvious nitrogen shortage during the growing season. He has demonstrated that normally there is relatively little uptake of nitrogen by the roots after September but that the application of urea to the leaves at flowering time can raise the protein content of the grain. On one site in the wet year 1952 where the available nitrogen at planting time was 2.5 times the nitrogen taken up by the grain and straw during the subsequent growing season, a spraying with urea at the rate of 300 lbs/ac increased the grain protein of the Gabo crop by at least 3.7 per cent. and probably by 4.8 per cent. In the drier 1953 season the variety Spica when sown at the normal time (May-June) gave a significant correlation of +.86 between available nitrogen at planting and yield. There was a similar correlation of +.79 between available moisture at sowing and yield. There was, however, no correlation between available nitrogen at planting time and grain protein. These data taken in conjunction with the urea spraying experiments of Reeves (1954) suggest that most of the nitrogen is taken up during the pre-flowering stage. Reeves (*op. cit.*) obtained strong indications that the varieties which normally have the lowest protein content give the greatest response to urea sprays.

The result, in practice, is that substantial increases in yield may result from an improvement in the availability of soil nitrogen but the grain protein may be reduced. Data calculated from a trial conducted by McNeal and Davis (1954) under irrigation at Bozeman, Montana, U.S.A., show that the uptake of nitrogen by nine varieties at different levels of applied nitrogen was linear over the range tested. The manifestation of the response by the different varieties varied, some produced more culms whilst with others there was an increase in the number of grains per ear or in the average grain weight.

Seven varieties were grown at two West Australian Research Stations by Watson (1953) at three levels of nitrogen, "nil", 1.5 cwt./ac and 3 cwt/ac of sulphate of ammonia at seeding time. At the Avondale Research Station the growing period (May-October) rainfall was 11.34 inches and the soil a medium loam while on the lateritic sandplain soil of the Wongan Hills Research Station the growing period rainfall was 9.55 inches. In these trials, as in those of McNeal and Davis (*op. cit.*), the yield response to applied nitrogen was often associated with a tendency towards a lower percentage of grain protein. The variety Ford for instance at Avondale gave an increase in yield from 11.3 to 18.9 bus/ac with a decline in grain protein from 13.2 per cent. to 11.1 per cent.

It has been suggested by White and Black (1954) that the observed uniformity between varieties in total nitrogen per acre is due to their exhausting the supplies of available soil nitrogen. Investigations at the Waite Institute (1925-33) have shown that by harvest time in the cropping year the supplies of both moisture and available nitrogen are exhausted to a depth of about five feet.

The general experience that drier districts usually produce grain with a higher protein content may be due in part to moisture becoming the limiting factor early in the season.

Agronomic Aspects

It would appear from the above data that if the protein content of the wheat crop grown over much of southern Australia is to be increased substantially, it will be necessary to improve the organic matter and nitrogen status of the soils upon which they are grown. A very substantial increase appears to be required in the amount of soil nitrogen that is available during the pre-flowering stages of the crop, as it seems that it is during this period that reserves are accumulated to meet the needs for both grain production and grain protein synthesis. In recent years there have been many reports from southern Australia of gains in yield and protein content following the inclusion of leguminous pasture in the farm rotation.

At the Walpeup Experiment Station in the Victorian Mallee, where the growing period rainfall is only 8.5 inches, (Miller 1951) the crop after ten years of barrel medic (*Medicago tribuloides*) pasture was compared with that grown on land which had carried volunteer non-leguminous growth for a similar period. The legume resulted in the yield being increased from 23.3 bus/ac to 30.0 bus/ac and the grain protein from 8.7 per cent. to 10.2 per cent.

Under slightly better rainfall conditions at the Wongan Hills Research Station in Western Australia (Rural Research 1954) three years of sub-clover added twice as much nitrogen to the soil as did a similar period of non-leguminous volunteer pasture. By planting time in the fourth year the difference was equivalent to 5cwt/ac of sulphate ammonia and this probably accounted for the yield being increased from 14.0 to 19.7 bus/ac. The protein content of the grain was raised from 7.1 per cent. to 9.8 per cent. by the sub-clover.

Such results suggest that in many instances leguminous pastures can raise the fertility status so that there is a substantial increase in both yield and grain protein.

Economic Implications

The payment of substantial premiums to farmers for high protein wheat need not necessarily result in dearer bread, because as has been pointed out by Sutton (1954) the increase in protein content is associated with greater water absorption. Additional loaves will be produced per sack so that the baker will require less flour. There are marked differences between varieties (Millington and Remilton *op. cit.*) both in their capacity to absorb water and in the increment in absorption per unit of protein increase. The variety Gabo is much superior to Insignia 49 in both of these aspects of water absorption, see Figure 1.

Yield and protein figures from South Australia and Western Australia have been presented above for the varieties Gabo and Insignia 49, for which water absorption data are available.

It has been shown that over twenty trials in South Australia Gabo yielded 4 bus/ac less than Insignia 49 so that with wheat at 12/- per bushel, a premium of 2/- per bushel would be required. This represents a charge of 96/- per ton on the flour. The gain in water absorption of 6.5 per cent. would enable the baker at the current price of flour (about £33 per ton) to pay about £2/5/0 per ton more for the flour leaving a deficit of fifty shillings per ton. This would amount to less than one-halfpenny per loaf. Moreover, the use of inherently stronger Gabo flour would result in a great improvement in crumb quality, while the higher protein content would result in the bread keeping fresh for a longer period.

For Western Australia the mean grain protein percentages in the 1953-54 season

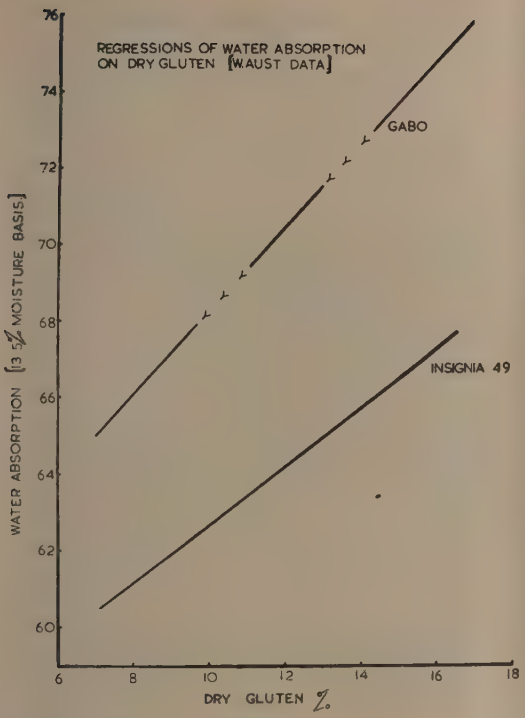

Figure 1.

Regression of percentage water absorption on dry gluten for the varieties Gabo ($b = 1.0824 : r = 0.78$) and Insignia 49 ($b = 0.7625 : r = 0.82$.)

trials were Insignia 49, 9.5 per cent. and Gabo 10.5 per cent. giving water absorption percentages (based on approximate flour proteins) of 61.5 per cent. and 67.7 per cent. respectively. The 6.2 per cent. gain in water absorption is similar to that for South Australia.

Because of the relatively better yield of Gabo in the Western Australian trials the premium required would be about eightpence per bushel. As the wheat would be "worth" about tenpence per bushel extra to the baker, its use could result in cheaper rather than dearer bread.

Urea Sprays

The economic aspects of urea spraying are related to the magnitude of the gains in protein content and water holding capacity which result from the application of the spray. Reeves (*op. cit.*) has shown a gain of approximately one per cent. of protein per 20 pounds of urea sprayed on the variety Charter. This in turn will give increases in water holding capacity of 1.5 per cent. and in the value of the flour of ten shillings per ton. On the basis of the yields quoted by Reeves, two acres of wheat would be required for a ton of flour so that the return from 40 lbs of urea would be ten shillings. Such an analysis disregards the gain in flour strength resulting from the increased protein and in the subsequent response by crops and pastures to any unexpended urea.

A heavier rate of spraying, 80 lbs/ac, gave a yield increase of six bushels per acre and an increment in protein of 2.5 per cent. For 160 lbs of urea there is an extra 12 bushels of wheat and a gain of 3.7 per cent. in water holding capacity giving an added value of £1 per ton to the flour. This would be much more satisfactory financially than would the lighter dressing.

Summary and Conclusions

Detailed examination of grain and plot yields from variety trials conducted by the Departments of Agriculture of Queensland, South Australia and Western Australia generally support the suggestion that there is a tendency in a region towards a constant yield of protein per acre.

The profitable production of substantial quantities of wheat with a higher protein content in southern Australia is therefore likely to be associated with an increased use of leguminous pasture leys as these are likely to increase both the grain yield and the nitrogen content. It has been demonstrated also that urea sprays may be profitable if premiums are paid for the higher protein grain resulting from its use.

Although the profitable cultivation of the higher protein varieties on many farms may at present require the payment of a premium to the grower, it has been shown that this need not result in

dearer bread but rather, at little or no extra cost, in a better textured loaf which would be of superior keeping quality.

It would appear that because of its economic importance increased attention should be given to water absorption in wheat breeding programmes. The variety Gabo is outstanding in respect to this characteristic.

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References

Berg, S. O. (1941)—Uber die Beziehungen zwischen Kornerertrag, Rohproteingehalt und Rohproteinertrag verschiedener Weizensorten sowie ihre zuchterische Bedeutung. *Z. Pflanzenzüch.* **23**: 542-561.

Breakwell, E. J. and Hutton, E. M. (1939)—A Protein Survey of the South Australian Wheatbelt. *J. Aust. Inst. Agric. Sci.* **5**: 103-6.

Grant, M. N. and McCalla, A. G. (1949)—Yield and Protein Content of Wheat and Barley. *Can. J. of Res. C*, **27**: 230-240.

McNeal, F. H. and Davis, D. J. (1954)—Effect of Nitrogen Fertilisation on Yield, etc. *Agron. J.* **46**: 8: 375-8.

Mecham, D. K. and Brother, G. H. (1950-51)—Wheat Proteins. U.S.D.A. Yearbook 1950-1: 621-27.

Miller, W. B. (1951)—The Economic Aspects of Soil Fertility Maintenance. Proc. ANZAAS 1951.

Millington, A. J. and Remilton, E. (1954)—Flour Strength of Australian Wheat Varieties. *J. Aust. Inst. Agric. Sci.* **20**: 24-35.

Neatby, K. W. and McCalla, A. G. (1938)—Correlation between yield and protein content of wheat and barley in relation to breeding. *Can. J. Res.* C, **16**: 1-15.

Reeves, J. T. (1954)—Some effects of spraying wheat with urea. *J. Aust. Inst. Agric. Sci.* **20**: 41-45.

Rural Research in C.S.I.R.O. No. 8: 16-22.

Sutton, G. L. (1954)—(Private communication).

Waite Agricultural Research Institute Report (1925-33): **15**.

Waring, S. A. (1951-4)—Mimeo Reports, University of Queensland Department of Agriculture, (1952-3) and (1953-4).

Watson, E. R. (1953)—An investigation of various aspects of flour quality in a number of wheat varieties. M.Sc.(Agric.) thesis, University of Western Australia (unpub.).

White, W. C. and Black, C. A. (1954)—Inverse yield—nitrogen law. *Agron. J.* **46**: 7: 310-315.

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THE VICTORIAN DEPARTMENT OF AGRICULTURE AND ITS RELATION TO PROGRESS IN THE STATE

By H. A. MULLETT

It is proposed to deal with two aspects firstly to show how the Department of Agriculture has accelerated progress in the past, and secondly to show how this rate can be improved in the future.

What has been done in the past can only be seen in proper perspective when viewed against the background of the state of knowledge at the relevant times and in the light of the obstacles that were overcome.

Agriculture has always been the biggest industry in the State of Victoria, its production averaging £290 *m.* per annum in recent years. In addition to providing the food for all the people within the State, and raw material for much of their clothing, it has always contributed over 90 per cent. of the total value of exports. This means that the import trade was and is dependent upon it, and that overseas debts cannot be serviced without it. In view of this, it is a little difficult to understand why, until recent years, it was such a long, uphill fight to get the general public to recognise the importance of efficient agriculture, and the need for adequate expenditure on scientific means of increasing production and reducing production costs.

Initial Difficulties

The undertone which, by and large, characterised public opinion for many years was that the man on the land, notwithstanding that cheap land had been made available by the State, was continually in need of public assistance because of economic adversity, or because of drought, fire, flood or some pestilence. Moreover, his role was to provide cheap food for the masses and his surplus production was inevitable and even embarrassing. Why nurse him any further, they asked?

It took the second World War to drive home to the man in the street that constant, regular, and adequate supplies of cheap food stuffs are by no means inevitable, that an expanding agriculture must be carefully planned, that adequate scientific personnel are necessary to successfully prosecute research and extension, and that costs can mount as rapidly in agriculture as in any other industry. Importers have always been an influential section of the community, but it took severe import cuts imposed by the Commonwealth Government to arouse them to the dependence of their business on agriculture, and, at the same time, they took active, if independent steps to call for increased production.

The dependance of the secondary industries on an efficient and progressive agriculture need not be stressed, but when this powerful section of the community throws its full weight behind the development of agricultural efficiency, then the wheels of progress will turn still faster.

The efforts the Department has been able to make in the past must be viewed in the light of these facts, but the attitude of mind alluded to earlier was largely passive. It was the least of our difficulties when I joined the Department in 1913. The main problem we had to con-

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tend with then was the opposition, even hostility of many of the farmers themselves to science, and to progressive legislation designed to improve their lot. It was not that they were not confronted with many problems. Wheat growing, for example, was a chancy business, everybody was struggling, especially in the northern Mallee which was just being opened up. Pastures in the dairy belt, except on exceptionally fertile patches, were thin and infested with weeds like flat carrot weed, rib grass and various dandelion-like species. Prices for dairy produce were low, and conditions on the farms poor. Contagious pleuro-penumonia of cattle was then endemic in Victoria, bovine tuberculosis active in some areas, anthrax and other diseases of stock common. Sheep husbandry was confined largely to native pastures of relatively low productivity. On very considerable areas you could not rear a fat lamb, and in some cases not even the lamb. Irrigation settlers were being placed on the land in the Goulburn Valley, and there had been no systematic experimental work on the crops they were advised to grow. So-called agricultural experts abounded both in and out of the Department, and every now and then on the platform and in the Press, the Department was flayed without mercy.

When Dr. S. S. Cameron, the then Director, reorganised the Department in 1911 in order to place it on a scientific basis, he met with fierce opposition, and both he and the agricultural graduate he appointed to assist him, A. E. V. Richardson, were haunted by this, and by press hostility for many years.

This point of view was not unnoticed by Governments, by Parliament and by the Treasury, and, naturally, Ministers of Agriculture could not be indifferent to it. When one Minister, who was with us for a number of years, publicly expressed his disbelief in the practical value of science to agriculture, no doubt he was expressing his own opinion, as well as that of most of his constituents.

Increasing Popularity

What then brought about the change in the present situation, when the Department cannot keep pace with the demands made on it for research and extension work? Broadly speaking, it was due to the Department ultimately convincing the farming community by actually delivering the goods. No amount of propaganda about the wonders of science, no addresses however eloquent, no publications however well written, no promises of future results however sincerely presented, would have availed against the dead weight of disbelief which, in part, was a reaction to the Department's previous efforts, and in part, no doubt, arose from the sincere conviction of many farmers who took up farming with little experience, learned their farming by trial and error, and who, naturally, could not understand how their problems could be solved by people with another type of education.

It was clear that Departmental advice could no longer be founded upon traditional methods or upon assumptions, but had to be based upon proven facts. This led directly to the setting up of the State Research Farms at Werribee and Rutherglen, and to the decision to appoint graduates in agricultural science to the staff.

The first position in the Department available to young agricultural graduates was that of Science Cadet at £125 per annum, and this was no better than the few private employers were prepared to give. Naturally, this offered little inducement to young men to undertake a four-year course at the Melbourne University. Ultimately, Dr. Cameron persuaded the then Government to enact the University Agricultural Education Act, under which capital monies were furnished for a University building, and an annual subsidy provided to assist the University to continue the course.

The University was required to provide up to 20 free places a year, and the Government undertook to appoint on yearly contract with the Minister up to six graduates per annum at a salary of not less than £300 per annum.

This Act, which having regard to the times, was a bold stroke ensured a steady flow of undergraduates to the University, and graduates to the Department of Agriculture for a number of years. However, as time went on, the Victorian Public Service was outbid for many of these.

Important Research Results

In the early years, the problem of conducting a realistic programme of scientific investigation with two or three graduates was formidable and necessitated concentration on one industry.

Richardson had had practical experience in wheat breeding in South Australia. He trained Geo. Gordon in this work and closely supervised it for some years.

A steady stream of new varieties resulted. These superseded those in use, and the practical benefits pleased the farmers. Now over 90 per cent. of the State's acreage is sown to varieties bred by the Department. No variety is distributed unless it is superior in some important respect to existing varieties, and nothing is released until it has been thoroughly tested in the field.

Assessing the improvement in yield at a modest 2 bushels an acre, and taking the gain in production at recent prices, this means that farmers have had £3 *m.* per annum placed in their pockets in recent years. Systematic experiments conducted in the field gradually brought to light detailed authoritative facts on each phase of growing wheat crops throughout the State, so that now there are very few gaps in our knowledge of the technique of successfully growing this crop.

The problems outstanding in the wheat industry today are:

(1) improving the bread-making qualities of our wheat,

(2) improving the fertility of wheat soils, and

(3) incorporating resistance to rust in the varieties.

I do not make light of them.

Farmers in the Wimmera proved to be the most receptive to the Department's efforts, and it was, therefore, on them that it was decided to concentrate first. The annual field days on the Departmental experimental plots in the Wimmera provided many striking examples of improved wheat growing techniques. Large numbers attended and enthusiastic interest was aroused. This was further stimulated by the development of crop and fallow competitions throughout the wheat belt, the Department having been impressed by the good results that flowed from a single example at Nhill. Since then crop and fallow competitions have spread throughout the wheat belt of Australia.

The practical results achieved in the Wimmera excited the interest of wheat farmers in other districts, and this resulted in the Department being requested to extend its work elsewhere, and this led to more staff being provided.

When the State Research Farm at Werribee was established, British migrants were being settled in the Goulburn Valley, Werribee, and elsewhere. Prior experimental work on an adequate scale had not been undertaken before this very considerable undertaking was actively under way.

Lucerne was the principal fodder crop advocated, and early work at Werribee was concerned with working out the best way of growing it. Gradually, however, it was realised that extensive areas in the irrigation districts were not entirely suitable for lucerne. By that time the Department at Werribee had proved that

English rye grass, cocksfoot, alsike, white Dutch clover pastures could be grown under irrigation, and would support a dairy cow to the acre under intensive management. The techniques of watering, manuring and managing the pastures were worked out and these now form the basis of production in many of the irrigated areas of the State.

Early work by the Departmental chemists, Dr. Howell and A. N. Pearson, had demonstrated that superphosphate in relatively light dressings could profoundly influence the yield of wheat. In view of this, it is strange that no persistent interest appears to have been taken by them or other workers in applying superphosphate to pastures.

Dr. T. Cherry, Director of Agriculture, set up, in 1905, some pasture top-dressing plots in collaboration with the Chamber of Agriculture, but there is nothing to indicate that these plots produced results which excited the interest of anyone, at all events the effort lapsed, and it is certain that no top-dressing with superphosphate was being done anywhere when Richardson sowed down his first plots at Rutherglen State Farm in 1912.

The results with superphosphate in this field of 2½ acres of native *Danthonia-Themeda* pastures were spectacular. Trefoils were not apparent anywhere on the "no manure" field, yet in the Spring they comprised 75 per cent. of the herbage on the superphosphate 1 cwt. plot. A search showed that without the stimulus of the superphosphate, trefoils, though present, were so minute that they could not be seen without a "hands and knees" inspection.

Those farmers who then saw these plots showed no real interest in them for they were then obsessed with the popular desire to grow wheat. This work was continued and expanded at Rutherglen, but the War intervened and it was not until 1919 that a series of pasture top-dressing plots were set up in the Western District. Spectacular results were obtained on most of these plots, except that at Wickliffe where no trefoil made its appearance.

The small farmers in these districts showed keen interest, but so grouted in the belief that native pastures must not be disturbed were the woolgrowers, that they were unreceptive. Indeed, in this state of mind, the then President of the Hamilton A. and P. Society declined to sponsor the first field day in that district although a very remarkable response was visible.

Next year on the plots at Wickliffe it was demonstrated that subterranean clover, only then beginning to find a place in Victorian agriculture as a result of advocacy of T. J. Smith of the Department, could be established by top-sowing without cultivation, provided superphosphate was applied as well. This was an important step.

When farmers tried strips of superphosphate in open paddocks they often reported to us that the result was a failure, but examination on the spot usually demonstrated that the stock had concentrated on the manured portion. Perhaps Cherry's plots were not fenced.

Many striking examples, especially on "cripply" country in coastal areas of the Western District could be cited of the way in which top-dressing with superphosphate has profoundly altered Victorian pastures, but I will not go further into that, except that I wish to say that I believe that the active efforts of the Victorian Chamber of Agriculture in co-operating with the Department in many field plot demonstrations in the country at the time, and the advent of the "Better Farming Train," contributed materially to getting the practice of top-dressing over to the farmers.

It took at least 10 years before top-dressing was widely accepted. Today over 7 million acres are top-dressed, and the appearance of the pastures in the moister districts of the State and their productivity have been transformed. The

regular cutting of grass hay has also been made possible by top-dressing and this product has become an important article of commerce. Of course, the cutting of it has been greatly accelerated in recent years by use of labour saving machinery, and it now makes a substantial contribution to the stability of our agriculture. In the last 10 years the tonnage of grass hay conserved has increased from 220,000 tons to 825,000 tons per annum.

In southern Australia we have always been in need of suitable pasture species to improve the carrying capacity of soils in the wheat belt. To be useful any species must be harvested with reasonable ease, and, if an annual, should have the power to regenerate itself for a reasonable time. Wimmera rye grass, discovered in 1919, though it has its faults, met these conditions, and, in association with subterranean clover, proved valuable also on soils in the moister areas outside the wheat belt too low in fertility to grow perennial rye. It proved useful under irrigation also in association with subterranean clover on non-intensively managed pasture. Today, many millions of acres are sown down to it in southern Australia.

Selection and breeding work of this species suggested the possibility of improving other species, and this led directly to the pioneering selection work at Burnley with subterranean clover, and to research into agrostological problems being undertaken there and elsewhere in the State. The successful results obtained led to keen interest by us in Victoria in the value of strain in pasture species to the selection of superior strains, and to the setting up of seed certification schemes designed to protect this seed from adulteration. A considerable trade in certified perennial rye, various strains of subterranean clover, *Phalaris tuberosa*, irrigation white clover, and so on, developed and an effective seed testing laboratory was also established.

I have given some concrete examples of the early commercially-useful results which followed from the decision to place the Department's agricultural teaching on a scientific basis, so that it can be seen how the Department delivered the goods and how the confidence of the farming community in scientific work on plants was won.

Very many other worthwhile practical results could be quoted but there is not time. A few more examples must suffice. The ley farming work with subterranean clover at Rutherglen has shown how the customary fallow which precedes the wheat crop can be dispensed with in the north-east and on the western plains.

Potash has been shown to be deficient in certain of our pasture areas, and the farmer has been told how to correct the deficiency. Zinc has been shown to be deficient in some Wimmera soils, and applications of small dressings of zinc sulphate are being profitably used there. Of course, the molybdenum story is only now being worked out.

Studies into the relation between the health of fruit trees and leaf symptoms by the Department enable farmers to be advised how to correct mineral deficiencies including those caused by a deficiency of trace elements.

Work on the respiration of apples under cool store conditions has enabled colour charts to be prepared so that the picking of apples can be done at a time likely to promote the greatest storage life.

The plant Research Laboratory at Burnley has worked out the practical techniques used in orchards and vegetable gardens for the control of many insect and fungus pests. In collaboration with the Air Force, the techniques of aerial spraying of grasshoppers, so successfully applied in recent years, were formulated and tested.

With animals much has been accomplished of practical importance by

applying well known techniques. Pleuropneumonia of cattle is no longer endemic in Victoria, and when it reaches this State from other States, as it does occasionally, it can be successfully controlled as has recently been demonstrated. Calfherd vaccination for C.A.E. with Strain 19 vaccine has proved very popular and effective since the present service was provided by the Department. Vaccinations for C.A.E. are now of the order of 80,000 a year. Over 400,000 dairy cattle have been T.B. tested by the Department since the introduction some years ago of its programme to eliminate bovine T.B. from all the dairy herds of the State.

All these things may seem simple in an age when children play with space machines, but they are the kind of results we need to increase production. These and similar results constitute a challenge to the younger generation of scientists. The practical problems of the times were met and solved. The continued confidence of the community in scientists, in the long run, will depend on similar practical results following scientific effort.

The Staffing Problem

Now let me deal with a current problem. In the Department we have an organisation consisting of 1,190 officers and employees, including 168 University graduates. Our expenditure this year will be £1,708,000, and our revenue is likely to be £376,000.

This staff is necessary to provide the regulatory and other services arising out of the provisions of 38 Acts of Parliament administered by the Department, to conduct research into all forms of plant and animal production, and provide the extension facilities. It is also necessary to enable us to run two Agricultural Colleges, as well as the School of Primary Agriculture and Horticulture, and a School of Dairy Technology, eight Experiment Farms, two large farms at the Agricultural Colleges, and to supervise experimental work on hundreds of private farms. By the way, we are also in the export cool store business in a large way. In addition an active part is played by Departmental officers on the Standing Committee on Agriculture, and its associated technical committees, and a number of boards and committees must be serviced.

We have to find and retain personnel appropriate to the work, and conform to the requirements of the Public Service Board in all appointments, rates of pay and conditions. We need scientifically qualified officers of graduate ranking, also men trained in Agricultural Colleges where this is appropriate, and various other grades, such as Dairy Supervisors where the qualification is mature practical experience and ability to pass a special entrance examination. We believe in graduates managing graduates, and, therefore, we have to provide experienced graduate personnel for this function as well.

Once outside organisations began to appreciate the services of graduates, we suffered losses of experienced officers, and over the last 10 years it has not been possible to recruit sufficient young graduates to make up wastage, and to provide sufficient men of the right kind to permit of all the expansion desired. It is not difficult to recruit men for laboratory work in Melbourne in plant pathology or entomology, but there is a chronic shortage of agronomists to carry out experimental programmes on State Farms and other work in the country. Plant breeders and people willing to undertake agrostology research work in the country are in short supply. Young graduates have not been interested in extension work. We have been unable to obtain any new graduates interested in horticultural research during the last two years. We are endeavouring to build up a sufficient graduate personnel in the Dairying Division to service the dairy industry, but despite scholarships to enable training at

Massey College in New Zealand, the number offering is inadequate to our needs. The tobacco industry has a number of acute problems, and we need more graduates to service this industry and to staff the Tobacco Research Station at Myrtleford.

It is undoubted that the trend of production in Victoria has swung definitely to increased numbers of livestock. The total live stock numbers in Victoria are an all-time record. The sheep population reached an all-time record in 1952 and is very little below it now. Wool production in 1952-53 was an all-time record. The total meat production in 1952-53 was an all-time record. The number of dairy cows and their production is at a record level. The beef cattle numbers reached record figures in 1952-53. Beef and veal production in 1953-54 was an all-time record. These figures are not freak figures but represent well defined upward trends.

Anticipating this trend, we set up an Animal Husbandry Centre at the Research Farm, Werribee, several years ago, and a Dairy Research Centre at Ellinbank. We need graduates to adequately staff these institutions. We need graduates to undertake teaching at the Agricultural Colleges, and an entirely new staff for the Dairy College which is in course of development at Glenormiston. In common with most States, we find that graduates do not readily take to soil survey work. It may well be, as has been stressed so often, that the salary levels in the Service were responsible in part for some of our difficulties, but this is not the whole story. It goes much deeper than salary and is concerned with the mental attitudes and ideals that are common today. I do not think that it is recognised what interest, satisfaction, and dignity there can be in a career that serves the nation, the State, and one's fellows by increasing the productivity of the good earth. It is a question I would like to see the Institute take up, and keep before the public continually.

The Institute has taken a step in the right direction in actively bringing before the notice of parents, scholars and head masters, the opportunity for a worthwhile career that exists in agriculture.

Some of the post-war developments throughout Australia have been planned without regard to where the personnel was to come from, or, alternatively, without regard to the effect on existing organisations. After careful study, I am certain, unless adequate steps are taken to co-ordinate the agricultural research and extension work now being planned throughout Australia, to assess the number of graduates required, either to regulate the rate of development or to stimulate effectively the numbers entering Universities, much of the programme must be delayed.

Now that the Standing Committee on Agriculture has a special session for the consideration of research problems, some attention is being given to the staffing question and Governments have been acquainted with the position. The better status recently offered officers of the Commonwealth and State Services should do something to redress the balance. Nevertheless, all concerned, particularly in this State, should redouble their efforts to keep this important question alive.

This problem is the greatest one in the field of agricultural progress today and the rate of future progress in agriculture depends on a practical solution being found.

The Extension Problem

Our principal shortage of graduates is in the extension field. Steps were taken, first to utilise the staff we had to better advantage, and, second, to specially recruit additional graduates for this work. It had been shown for some years that the team of orchard supervisors could perform useful extension functions. With

this precedent, it was decided to utilise the services of 80 Dairy Supervisors in the field, and 27 Stock Inspectors. Brief special courses of training at our rural training centre at Dookie College and elsewhere were instituted, and the men themselves have enthusiastically entered into the programme which is continuing.

Twenty-four scholarships with a specially attractive living allowance during the course were offered undergraduates in agricultural science who would agree to enter the district extension service of the Department. Twenty of these have already been awarded. Seven experienced graduates have been in their districts for a number of years. The new recruits will enable us to set up a District Agricultural Officer and an Assistant in each of the twelve regions of the State.

Scholarships are likely to be offered to students to provide a steady flow of graduates for agronomy work and for staff expansion and replacement at the Agricultural Colleges.

For many years now, a number of annual scholarships have been awarded to matriculated students to enable them to complete the course in Veterinary Science at the Sydney and Brisbane Universities. A regular recruitment of veterinarians became necessary in order to enable us to reach a field strength of 45 veterinary officers as rapidly as possible so that in addition to their normal duties of the prevention of stock diseases, the T.B. testing of the whole of the dairy cattle of the State could be speeded up.

The extension field then is the one that we are concentrating on and it is being given priority in recruitment over most other forms of graduate employment. We are giving in-service training to new recruits and stimulating interest, study, and discussion in the newer techniques including up-to-date psychological approach to influencing communities.

We have greatly stimulated our information service with its moving sound picture production, printed matter, and its radio programmes. We have successfully launched the "Voice of Agriculture" programme on the 17 regional stations. We prepare the discs and stress the direct practical approach, especially by the question and answer method. Our estimate that the real farmer was somewhat fed up with propaganda and would welcome the plain technical facts on actual practical problems, appears to be justified. We believe the radio to be the most powerful medium today in reaching farmers, and so we are concentrating on it.

In our Journal of Agriculture we have to cater for all sections, and it is the official reporting medium on many subjects. This Journal is popular, but it does not continuously service each industry. We are now doing this with our "Digests." Twenty thousand dairy farmers receive the "Dairy Digest" every two months, 15,000 live stock owners receive the "Live Stock Digest" every three months, and 5,000 potato growers and 5,000 horticulturists along the Murray receive similar publications. We expect the wheat growers shortly to receive similar advantages.

Our Mobile Extension Unit which provides a three-day programme of demonstrations and lectures at each country centre visited is another new extension activity. Last year this unit was viewed by 13,000 adults and 3,050 children. At present we have to service it with a team which changes with each district, but with adequate staff we could provide a permanent team and so improve its usefulness.

Hitherto the extension field has been looked upon as if it were the sole responsibility of the Department to organise; the extension receptivity likewise. I strongly believe that we must get the organised farmer industry bodies actively engaged in the practical job of increasing interest in local work, and in improving the quality of the programme. As a start we have set up an Extension Committee,

the membership of which includes not only the principal departmental officers concerned, but also the representatives of the various industry bodies. The charter of this Committee is to review the whole field of extension work in the State, and advise on means of extending and improving it. For example, the Mobile Unit and its programmes, how they meet local needs, how to increase interest in its programmes, how to increase attendances and the formation of local committees to do this; the Departmental radio programmes, their content and presentation, and how they meet local needs, and so on. The possibilities of this body are very great and should result in the kind of co-operative service that is essential for the highest efficiency.

Experience has shown that where agricultural industry organisations carry their own resolutions on technical matters without consulting the Department, their progress is often tedious. Of course, I do not say that in the past this public discussion has not proved of value or that it has not stimulated those in authority to action. I am convinced, however, that where the subject warrants it, rapid progress can be made in committee where the industry bodies are represented by practical men and where they meet the Departmental officers with the knowledge of the administrative and technical details. I am fortified in this by the excellent work done recently by the Foot-rot Committee in which the Department, the Graziers' Association, the Wheat and Woolgrowers' Association, the Chamber of Agriculture, and the Australian Primary Producers' Union, worked out the basic principles of legislative and administrative steps for consideration of their respective organisations, and the Minister.

Producer industry bodies throughout Australia have already been invited to subscribe to research programmes, and some success has resulted. If this move is brought to fruition it is bound to result in active participation by representatives of primary producer organisations in the formulation of research programmes in the Commonwealth sphere and in each of the States.

The pattern then I see developing in the future is for industry bodies to take an active part in the development of a progressive agriculture, and taking that part in committee to the better understanding of both parties.

In the sphere of Commonwealth-State relations, the research section of the Standing Committee on Agriculture is the Committee which can do much to integrate our services with those of the C.S.I.R.O. The technical conferences arranged by that body are resulting in a better understanding between research officers and better knowledge of their work.

Conclusion

In this talk I have endeavoured to show—

(1) The practical importance of the Department's work in increasing efficiency of production in this State,

(2) That public support for work of this kind was hard won and its continuance is dependent on worthwhile practical results continuing to be achieved,

(3) That the supply of trained manpower has always been short of the needs. This shortage appears likely to continue unless comprehensive and positive steps are taken to overcome it, and

(4) That the producer industry bodies should play an increasingly important part in raising the efficiency of primary production.

I pose a last question which I have not raised before—How does agricultural science attract a greater share of the best young brains of the community?

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A summary of the discussion following this address is given on page 87.

THE ROLE OF UNIVERSITIES IN THE SCHEME OF THINGS

By S. M. WADHAM

I would like to start with a point raised during the discussion of Mr. Mullett's talk — that is, that not enough biology is being taught in schools and we are not putting before youth the fascination of agriculture. This is, of course, quite correct, and it is most unfortunate. Most British universities have thoroughly bad and unbalanced science courses—and Melbourne is no exception. Too often they involve specialization in only one or two subjects, for example, various combinations of chemistry or of physics, in either case diluted with mathematics. People trained in this way are badly educated for science *as a whole* or as citizens in a world in which human affairs are not solely governed on rational lines.

Modern development is forcing specialization, and universities seem unable to resist it. This state of affairs is partly due to the administrative machinery within the universities: faculties largely fix the courses and the specialists inside individual schools within faculties have too big a say. We should be able to have both specialization and a broad approach.

As a result most science graduates have specialized in the physical and chemical sciences, and few are competent to teach biology in schools. In England this trouble is overcome to some extent because in some schools pupils are able to take preliminary university exams while still at school, but in Australia we don't trust schools to do this. If more biology were taught there would be more chance for biologists who have graduated, but so far most headmasters have not been prepared to arrange for teaching biology. This is because the difficulties of doing so are very real—including, for example, expensive equipment, lack of teachers and difficulty in obtaining biological material, but these difficulties could be overcome if policy was different.

Our over-specialization on chemistry and physics has resulted in the atom bomb and a civilisation which is not mentally equipped to be sure of controlling its use.

Some university staff think the prime function of the University is research. This is due in part to the publicity which some university centres of world reputation, like the Cavendish Laboratory, get. Such places have great funds available for research.

But teaching and training for citizenship are the main functions of a university. Unfortunately, teaching doesn't appeal to many university people, and professors and others are selected on their research rather than their teaching ability.

The functions of a modern university in my view are: First, to train people for professions, secondly, to carry out research on appropriate matters, thirdly, to provide, when called on, an unbiased opinion on matters of public interest, especially in the technical field. These functions differ from those of universities in mediaeval times.

Research is essential in any university because, unless it is in progress, the outlook of teachers gradually becomes purely pedagogic. Actually of course, there is no

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end to the need for the acquisition of new knowledge. Despite a spate of printed material, university staff cannot keep up to date without personal contact with principles and methods.

Independent opinion is especially important in Australia where there is a relatively small intelligentsia which is not at all vocal. We live in a pressure-group world where unfortunately the individual citizen gets lost. The university can take a lead in voicing independent opinion and so induce others to come in and add their weight on important issues.

In each faculty, research should therefore, be in progress in the main departments so that the teachers in each department may be kept intellectually alive and in touch with modern developments as well.

Clearly, in a faculty such as Agriculture, the range of subjects is so diverse that only limited sections in each constituent subject can be touched by these investigations.

A teacher in charge of a university subject should have a small research group he can guide. We have tried to do this at Melbourne despite accommodation difficulties.

Of the students taking a course at the University, not more than ten per cent. are potential research workers, a rather larger group are capable of carrying on investigations at a somewhat lower level and the balance are suitable for technical posts in a wide variety of occupations.

The course for a first degree must, therefore, be framed to give a wide training because few students know what their real capacities are or what they want to do when they begin the course—and a large proportion are not certain even at the end of it.

An agricultural student must be able to pass the first year of a science course. Because our faculty is in Agricultural Science, a student is no good to us if he cannot or will not absorb the basic scientific principles.

A broad course is no handicap to a future research worker because he can make contacts with many different aspects of the subject of his research. This is not so easy if his first degree course has been narrow and specialised. The curse of many modern scientific schools is their narrow outlook.

On the other hand, the first degree does not fit a man to be a research worker. The object of having a Master's Degree is that this extra knowledge should be made available to him and that he should get a training and experience in the correct method of approach to a research problem.

In recent years, the universities have been unable to do this work effectively. They have not had enough research money to hold post-graduate workers in competition with outside bodies. On the other hand, some research organisations have taken graduates with a first degree and expected them to do research work. Generally, these organisations are not in a position to train research workers and, consequently, good men are sometimes wasted.

The solution is to build up the University's capacity for research in those directions in which it is capable of directing it. If necesary, outside organisations can support the students for the Master's Degree although they are still in the universities.

This view does not envisage that a university will become a vast research centre but it does imply the maintenance of a proper balance between teaching at undergraduate level, and research carried on by post-graduate students guided by the lecturers.

The fifth, or post-graduate year is all-important. C.S.I.R.O. once took graduates at the end of a four-year course and put them straight into research positions in their Divisions. This was almost inevitably a failure, especially if the new recruits were not guided properly. I therefore now resist first class research men going to C.S.I.R.O. at that stage

For many years it has been obvious to most of us that the agricultural graduate must have more than scientific knowledge. He must get the idea of farm management and the reasons behind it. I am especially annoyed by people who talk about doubling the carrying capacity and production of land without realizing the many management and economic factors involved. Economic and sociological analyses of farming populations reveal the difficulties in securing the adoption of new ideas, and we cannot expect a great rate of progress. But it is very difficult to get the significance of these economic aspects into the minds of students, so many of whom are attracted by the vigour of many development programmes and are unaware of the magnitude of the obstacles. Pure science and applied science are interwoven in the agricultural course. The student must be encouraged to have a desire for more knowledge and shown how to get it and distribute it. Too many university lectures are dull and contain too much detail which can be got in later life from the principles which must be fully based and grasped to such an extent that the student can analyse a proposition in the light of the principles.

Our facilities should greatly improve when the additions to the School of Agriculture are completed. The numbers entering the course are increasing—perhaps partly influenced by the Institute's recent campaign. More than 40 have entered the second year—the largest on record. We are making a special effort to reduce the failure rate in the first year, and this was successful last year.

More boys from country high schools should be entering the course. In the past not many of these schools took pupils to matriculation standard, and parents were faced with the expense of sending their children to city schools. This difficulty is being remedied.

In the past, few agricultural graduates went in for teaching, probably because of the relatively low rate of pay for teachers. This disparity has now been largely corrected and we can expect that more graduates will be teaching in country high and technical schools. A task which seems to me of first rate importance in our agricultural structure.

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A summary of the discussion following this address is given on page 88.

THE PLACE OF RESEARCH IN VICTORIAN AGRICULTURE

By H. C. FORSTER

New knowledge of the science of agriculture over the past 50 years has undoubtedly aided increased efficiency in production and added materially to the areas producing foodstuffs in Victoria. With greater skills and better facilities there is every prospect that scientists will make even greater contributions in the years to come.

The Research Approach in Agriculture

When we compare physical and biological research processes, we find that the approach in biological research differs materially from that in the physical sciences. In the latter, scientists often know the basic facts and principles and from that knowledge proceed to develop new processes and concepts. In biology, we face a complex living organism about whose processes we have little real basic knowledge. The approach, therefore, in the first case is to accept the living organism and, by experiment, to determine the effect of various treatments on it.

The first approach of research to agriculture has therefore been largely the *ad hoc* approach, and this has achieved considerable advances in the past 50 years. We have seen:—

1. The direct application of overseas knowledge to Australian practices;
2. The adaptation of overseas cropping methods to Australian conditions as instanced in the development of the practice of fallowing in cereal culture, and the modification of overseas plants and animals to the Australian environment. For example, outstanding work was undertaken by Farrer and others in developing new varieties of wheat and similar success was obtained by the stud masters in producing the merino;
3. Pioneering research, particularly into the improvement of native pastures and the management of both annual and perennial pasture species; the development and use of trace elements in pastures and crops.

The second stage in the research approach concerns the why and the wherefore of observed facts. With this knowledge scientists are more likely to gain a basic understanding of the factors influencing plant and animal growth and, as a consequence, entirely new possibilities for improved production become apparent. Taking as an example the effect of molybdenum and lime in clover establishment, the basic research to determine the underlying theory of this reaction has materially affected the actual practice in the field. Research showed that molybdenum was essential for the proper development of rhizobia and that molybdenum was more available under alkaline soil conditions. Hence, in the field, if clover were not satisfactorily inoculated one would suspect deficiency of molybdenum as a possible cause, and secondly, if molybdenum were proved to be deficient, the situation might be remedied either by the addition of molyb-

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denum or, if the soil were acid, by the addition of lime in the area immediately surrounding the seed or, in extreme cases, by the use of both processes.

The third field of research to which very little attention has been paid in the past is concerned with keeping ahead of present agricultural practice in forecasting problems and difficulties that will arise in the future. Too often scientists have only come into the picture when troubles have developed in the field and a cure is required. In very few cases have scientists forecast troubles before they developed so that remedial measures could be adopted before production was affected. As in the case of medical science we can say that prevention is often the best cure.

These three stages of research are of equal importance and should be closely linked and, ideally, should proceed simultaneously. The applied investigation is essential, not only to solve the immediate problem, but to give the lead to the basic, more fundamental, attack. Further, it is not right for the fundamental scientist to work solely in his ivory tower. In biology we have complex interactions of plant, soil and animal, and the approach to research needs at all times to be kept wide. Workers in each of the three fields would gain much from contact with each other.

We can illustrate the importance of this multiple approach to problems by referring to recent trials which have been initiated by C.S.I.R.O. in conjunction with the State Department of Agriculture in Tasmania. In the case of one particular property, improved pastures were sown in 1930 and, by frequent top-dressing, carrying capacity was improved up to two sheep to the acre. Towards the end of the 1940's animal health troubles began to develop. Weaners failed to mature satisfactorily and wool quality decreased. In the following years, Departmental trials showed that potassium was deficient, and when potash was applied, pastures improved considerably. Recent C.S.I.R.O. research has pointed to the fact that both potassium and sulphur are important for adequate nutrition in the ruminant. The basic research problem, therefore, is to determine the importance of the effect of potassium or sulphur in the applied fertilizer—whether the potassium effect is solely on increasing the growth of the pastures; whether the potassium is effective by improving the nutritive protein value of the clovers in the pastures; or whether the potassium effect is on the internal ruminant digestion in the animal. It is obvious, therefore, that the co-operation of workers in the three phases of soils, plants and animals is necessary to solve the problem.

Some Aspects of Future Research

From the agronomic point of view, a most important field is maintenance of fertility of the soil involving studies on mineral nutrition, physical structure and organic composition. Increasing attention must be given to the microbiological aspects of soil fertility.

However, it is from studies of the interactions of plant, animal and soil that much can be expected in the future. These studies include:—

1. How to measure more accurately availability to the plant of mineral nutrients in the soil and in what form these are absorbed;
2. What is the effect of plant and animal residues on the soil and, more particularly, on the microbial flora;
3. The study of pasture, not as vegetation, but as fodder for the animal; modification of pasture composition, not to give the maximum amount of green growth, but the maximum amount of nutrient for the animal, to be available at the time when it is most needed.

Most valuable work has been initiated in recent years in the study of animal

production as distinct from animal health; the study of the physiological aspects of nutrition, particularly in the case of ruminant animals where the importance of the rumen flora has been demonstrated; the study of the whole field of the physiology of reproduction, and the study of genetics as applied to animal breeding.

Treatment of many plant and animal diseases and pests has undergone radical changes with the development of more powerful fungicides, insecticides and weedicides, such as the development of the chlorinated hydrocarbons and the outstanding success that has followed the use of growth-regulating hormones in the control of weeds. Research in this field will continue to produce even better control compounds. Basic physiological study of the mode of action of such compounds is invaluable and ecological research on the host animal or plant will give a guide to new methods of attack. In the control of cattle tick, for instance, recent work has shown that instead of dipping cattle in the summer when tick numbers are large and the pest is actively multiplying, better control is obtained by less frequent treatment during the winter when tick numbers are low and it is possible to reduce the population to minute proportions from which plague numbers cannot develop. A similar method of attack might well apply to other insect pests.

Genetics is playing an ever-increasing part in breeding species of both plants and animals which are resistant to disease. This method of attack has been most valuable in those cases where effective control treatments are not available. It has the obvious benefit from the point of view of the producer that the first cost in producing a resistant plant is the only cost involved, and time and labour spent in using insecticides or fungicides is avoided.

Research into many other aspects of agricultural production are obviously necessary, but space does not permit specific reference here.

One aspect of research, however, deserves mention. Too often we treat agriculture as the mere growing of food and neglect the fact that the farmer is the means by which this produce is obtained. There is an urgent need for more study of man in relation to agriculture; the study of the farmer's way of life; the adaptation of theoretically desirable processes to practical agriculture and the sociological and economic problems of agriculture.

Organization of Research

How can research best be encouraged?

There are three types of organizations engaged in research:—

1. *Private Enterprise.* Many commercial firms are interested in the testing and improvement of their products, but few in Australia are prepared to carry out detailed trials preferring to depend on parent bodies overseas to do such work. The industrial research institutes in both England and the U.S.A. play a very important part in adding to new knowledge not only in the commercial applied field but also in basic fundamental research as well. The recent moves by two Victorian enterprises, ICIANZ and Nicholas Ltd., to establish field stations and laboratories for active research in this State is an important step in the right direction. It is hoped that these may be forerunners of similar institutions to be established in this country.

2. *Universities.* Although teaching is a University's principal task, it has always been recognized that active research should accompany teaching. Proverbially the field of University research is in the fundamental field with complete freedom for the professor or lecturer to follow his own desire. There has, however, been a marked trend in recent years in certain Schools of Agriculture, to enter much more positively into applied research and much good work is being

done in this field, e.g., to quote typical cases, in N.S.W. in wheat breeding and pasture improvement in Northern N.S.W., and in W.A. in soil fertility and pasture breeding and improvement.

With the increase in numbers of agricultural students and in the size of the agricultural faculties, research by post-graduate students, as well as lecturers, will increase, and should play an important part in adding to our knowledge.

3. *Government Research.* It has always been taken for granted in Australia that the Government should bear the chief burden of conducting research for agricultural industry, and the State Departments of Agriculture and C.S.I.R.O. have been organized accordingly.

State Departments, in the light of their responsibility for agricultural production in their respective States, have a constant demand from their producers for solution of the day-to-day applied problems facing them, and the high standard of farming proficiency in this State is a tribute to the work of the Victorian Department. Generally speaking, the pressure of work is so great that the State worker seldom has the opportunity to follow up his applied problem on the more basic lines. This is often very disheartening to the research man.

C.S.I.R.O. by virtue of its constitution, has the responsibility for not only investigating the applied problem, but of seeking the why and the wherefore with the hope that this knowledge will lead to more efficient solution of our agricultural problems. Research of this nature is very involved these days. It demands the services, not only of the broad agriculturalist, but also of the specialist biochemist, physiologist, geneticist and biophysicist, and requires laboratories equipped with the most astonishing array of complex mechanical and electrical apparatus. The general efficiency of research in the physical and industrial sciences is ahead of that in the biological field and one of the advantages of C.S.I.R.O. in this respect is that, because of the relatively close association of primary and secondary workers in this organization, it has been possible, in recent years, to interest the physical research workers to use their very powerful tools in solving some of our biological problems. For instance, the use of the electron microscope has been invaluable in examining microscopic structure of virus particles, of the interaction of rhizobia in root nodules of clovers, and in determining the availability of mineral elements such as manganese in the soil.

A further example which is showing much promise is in the field of meteorology. The agriculturalist is materially concerned with climate and particularly in the micro-climate surrounding plants. The problems of measurement of evapotranspiration have been most difficult and empirical formulae have been used in the past. The physicists of C.S.I.R.O.'s Division of Meteorological Physics are now interested in both the theory and practice involved in micro-climate studies and they have already shown that several of our concepts are at fault and there is every prospect of their making a valuable practical contribution to our biological research.

But this all needs men and money in considerable amount, and neither are available in sufficient quantity at the present time.

We come, therefore, to the problem—how can we make the best use of all the facilities that are available, whether they are in the University, State Department or C.S.I.R.O. I suggest that we might well look very closely at the practices which have been developed in the U.S.A. where a somewhat similar set-up prevails and where a solution has been found in part by the freer interchange of facilities between the research organizations and the stationing of Federal staff at University and State Departments, and vice versa.

Much could be gained by encouraging further the close day-to-day contact that results when scientists on both the basic and the applied side are working side by side in the same institution. Such contacts should not be restricted only to the research workers concerned but should include the extension officers as well.

Finance

There appears to be no reason why Governments alone should provide the huge sums required for agricultural research. In secondary industry private enterprise provides the bulk of the money required. Agricultural producers and private agricultural manufacturers are now showing increased interest in providing finance for research either in the form of grants to recognized research bodies or in the formation of co-operatively controlled joint research institutes. Already considerable grants are provided by the wool and meat producers and moves are under discussion with tobacco and wheat industries.

These developments are to be encouraged. They may involve certain difficulties and perhaps changes in our administrative set-up, but the gain in the added interest of producers when they feel that they have a financial interest in the research will more than compensate for the disadvantages and should materially help in facilitating adoption of research findings in practice. An outstanding example of this sort of co-operation is provided by the Bureau of Sugar experiment stations in Queensland where the industry, in 1900, agreed to contribute £7,000 towards providing research and extension facilities for the industry. In the subsequent 50 years, so valuable has the service been, that industry now provides well over £100,000 and has, together with the Department of Agriculture, taken over the whole responsibility for the conduct of the research and extension work.

Training of Research Scientists

Shortage of trained personnel, whether for research or extension, is recognized as the main limiting factor at the moment in promoting the use of science in agriculture and the subject therefore merits particular attention by the Institute of Agricultural Science. As far as research is concerned, we must recognize that there is a very real limit to the number of people who have a research capacity and inclination and it is important that, for the greatest efficiency, these should receive the appropriate training to make them most valuable.

Considerable discussion has taken place in recent years on the training of research workers, particularly in the light of the fact that biological research has become highly specialized and men must receive advanced training in their respective fields. On the one hand, it is held that the research man should be trained in the disciplines of the basic biological and even the physical sciences and subsequently acquire his agriculture, while on the other, it is claimed that the broad basis of agriculture should first be absorbed and specialized training given in post-graduate years.

For my part, I believe that whatever the case for the biological sciences we will never attract more than the odd physical scientist to work in the field of agriculture which has too many unknowns and variables for the more precise physical worker. The basic requirement for a successful agricultural scientist is surely the urge to work with living things, the urge to grow plants and animals and to discover what makes them grow. Such a basis is encouraged in the broad course of agricultural science and is the best grounding for the research worker, no matter in what sphere he finally specializes.

It is vital, however, that adequate provision be made for the individual, once he has his pass degree, to proceed to a specialized two years in one of the science

schools such as chemistry or physiology, leading to an M.Sc degree. Not only will there be a need for a satisfactory arrangement to be made with the University Departments in question, but adequate financial bursaries or scholarships will be necessary to attract the brilliant man to undergo this additional training.

Conclusion

In summarising the main points, it must be stressed first of all that there are three phases in research—the *ad hoc* or applied, the basic, and the deductive type of research. Each is necessary in any organized research organization and each plays a part in helping the other.

In seeking for the better use of present available facilities and staff, it is desirable that there should be much freer interchange between the three organizations involved and that there should be better facilities for discussion between research and extension personnel.

Opportunities should be made to permit industry to take a more active part in discussion and co-operative management and financing of research.

(*Received for publication April* 20, 1955).

A summary of the discussion following this address is given on page 90.

APPOINTMENTS AVAILABLE

The Commonwealth Scientific and Industrial Research Organization invites applications for the following positions on the staff of the Organization.

RESEARCH OFFICER—LAND RESEARCH AND REGIONAL SURVEY SECTION.

Location: Katherine, N.T.

Duties: To conduct studies on animal production based on the utilization of native pasturages, supplemented by the by-products of a tropical dry monsoonal farming system. The investigation will include an ecological study of native pastures and the effects brought about by grazing. It will also include assessments of the values of native pastures and the various farming by-products including sorghum stubble, peanut hay, and the leys of introduced grasses grown as a part of a soil improvement programme.

Qualifications: University honours degree in science or agricultural science with research experience in pasture ecology and/or animal husbandry.

Salary: Within the range of Research Officer, £1,184-£1,730 p.a.

Note: (a) In addition the appointee will receive a District Allowance of £165 p.a. for a married man or £125 p.a. for a single man. A house with basic furniture will be available for rental for a married man. Bachelor quarters are available for a single man.

(b) Total leave accrued amounts to three months in each two-year period when free air fares to the nearest capital city and return are granted.

Applications, referring to appointment number 571/24 to the Officer-in-Charge, Land Research and Regional Survey Section, C.S.I.R.O., P.O. Box 109, City, Canberra, A.C.T., by 22nd July, 1955.

TECHNICAL OFFICER—DIVISION OF ANIMAL HEALTH AND PRODUCTION.

Location: At C.S.I.R.O. Cattle Research Laboratory, Rockhampton, Queensland.

Duties: To participate in the study of characteristics of breeds and strains of cattle in relation to their performance in a tropical environment.

Qualifications: University degree in biological, agricultural or veterinary science or equivalent qualifications.

Salary: Within the range of £890-£1,310 p.a. District Allowance of £25 p.a. (married) or £15 p.a. (single) is payable in addition.

Applications, referring to appointment number 231/3, to the Officer-in-Charge, National Cattle Breeding Station, C.S.I.R.O., Rockhampton, Queensland, by 15th July, 1955.

TECHNICAL OFFICER (MALE), DIVISION OF FOOD PRESERVATION AND TRANSPORT.

Location: Cannon Hill, Queensland.

Duties: To assist in investigations on the storage of chilled and frozen meat.

Qualifications: University degree or Technical College diploma in Science, Applied Science or Agricultural Science. Training in biological, especially histological, techniques desirable.

Salary: Within the range of £890-£1,310 p.a.

Applications, referring to appointment number 305/38 to the Chief, Division of Food Preservation and Transport, C.S.I.R.O., Private Bag, Homebush P.O., N.S.W., by 15th July, 1955.

PROCEEDINGS OF SYMPOSIUM ON "THE DEVELOPMENT OF SCIENTIFIC AGRICULTURE IN VICTORIA – PAST AND FUTURE"

The three preceding papers by Mr. H. A. Mullett, Professor S. M. Wadham and Dr. H. C. Forster constitute the addresses which were given at the symposium on "The Development of Scientific Agriculture in Victoria—Past and Future", held by the Victorian Branch of the Institute, at Burnley Horticultural School on April 20, 1955.

The symposium was chaired by Mr. B. F. McKeon, President of the Branch, and the following is a summary of the discussion which followed each address.

Discussion Following Mr. Mullett's Address.

Dr. I. F. Phipps, I.C.I.A.N.Z.: Stated that the A.I.A.S. could contribute to the future by examining possible trends in agriculture and drawing the attention of people in authority to these trends. The Institute could also develop ways of stimulating methods of taking advantage of this early knowledge of trends. Dr. Phipps said that the Institute was well aware of the shortage of qualified men and was doing its best to attract students to the agricultural course. Finally, he asked Mr. Mullett for his own views on how students of the right type could be attracted to the profession.

Mr. Mullett: It is important to improve the tone of public opinion towards Agricultural Science as a career which provides dignity and satisfaction. Too much attention is being paid to the question of salary and a poor impression of the profession could be created by undue stress for the need of improvement in this direction. We must always bear in mind the importance of holding up our profession in public estimation. At the moment, physics and similar sciences were attracting young men and the attention of business people. It was up to the Institute to point the way to influence people in general about the importance of agriculture. There could be a danger in any member of the Institute welcoming the situation of a poor supply of graduates and thus expecting higher status because of scarcity. We, as professional agriculturists, must be above this sort of thing. We must develop a high public spirit, keeping ourselves in the background and developing high ideals of the profession. When referring to attracting the best young brains in the community, I do not mean specifically "academic wonder boys." A special kind of brain and experience are required, if it is recognised that such men are important, they can be given the opportunity to train for a special place in the community. Any tendency towards snobbery in science should be discouraged and scientists should not be divided into classes such as (a) applied men, and (b) fundamentalists. Each type was worthy of his place in the profession.

Professor S. M. Wadham, University of Melbourne: Stated that he appreciated the difficulties of the Department in recruiting and holding staff. He agreed that salaries were not the only factor but they play a part in attracting men to the profession. He thought that the present level of salaries was reasonable but that the overall weakness apparently lay in the system of fixing salaries of professional people in the Public Service. Does Mr. Mullett consider that modification of this method is desirable?

Mr. Mullett: There were difficulties in replying specifically in view of his position as Director of Agriculture. He said he had noticed that some Agricultural Scientists thought that they should have better classifications than people in other professions. It would be hard for the Public Service Board to place Agricultural Scientists on a higher status than, say, Engineers who were employed by the State Rivers and Water Supply Commission. It then became a question of how the salaries of general professional officers could be raised. He explained that a method was available by which representatives of professional associations in appropriate industry bodies could put their claims before the Public Service Board.

Mr. Loder, Grazcos: Referred to the Department's inability, because of policy, to associate with industrial organisations in experiments. C.S.I.R.O., on the other hand, was willing to co-operate. Could Mr. Mullett say how industrial organisations could take a more active part in the development of agriculture?

Mr. Mullett: This could be done in two ways. One way was to make financial contributions for research and extension work. The other way was through an Extension Committee which had been set up by the Department

of Agriculture. Unfortunately, the Department, at present, had not the staff to meet the requests of industries to collaborate with special experiments.

Mr. A. J. Vasey, C.S.I.R.O.: Stated, as Convener of the Branch Committee on Undergraduate Affairs, that the committee's outstanding impression of graduates in recent years had been their sincerity. The uppermost question in their mind has been, "In what field can I be of service quickest to return to the community something for the University course which has been provided?" Salary has not been the main question and, on numerous occasions, to get into a particular field, graduands have accepted £300 to £400 less than the Department of Agriculture's starting salary.

The "general practitioner" of agricultural science was not in that form at the end of his university course, but was the product of treatment in the immediate post-graduate years. Dealings with raw graduates must be delegated to a special project leader who was a very key man in any set-up. The comparative ease of recruiting graduates for laboratory activities was, perhaps, the result of a system wherein a man delegated with a specific problem on which he had been able to publish a paper was judged accordingly and his progress in the profession thus attracted more attention than the G.P. C.S.I.R.O had had comparative trouble in recruiting people for long range work as a member of a team away from the laboratories. It was largely a question of community assessment with regard to the evaluation of relative contributions by individuals and by teams.

Mr. Costin, Soil Conservation Authority: The difficulty of recruitment goes far deeper than attracting graduates to the profession. The lack of biological training in primary and secondary schools greatly reduces the potential of research workers in these fields and this had resulted in a low percentage of scholars becoming interested in Agricultural Science. To overcome this the Institute should start a programme to attract and train students in biology well before the university level.

Mr. A. A. Lee, British Farm Equipment: Asked whether individual attention is being given by the Department to farm management, particularly on the business side. It would help farmers to have advice with regard to the priority of their activities.

Mr. Mullett: The objective of the Royal Agricultural Show competition in 1920 had been to pave the way for the appointment of staff to survey costing on farms, which was the basis of teaching farm management. Until recently, however, it had not been possible to induce any Government to appoint this type of man. Two men had now been appointed to obtain facts on which to base such advice. The problem now was to recruit officers of the right calibre to help these men.

Mr. G. H. Vasey, University of Melbourne: Does the Department propose to take an active interest in advising farmers on their machinery problems?

Mr. Mullett: Yes, when suitable staff is available. We aim to get the right man and then to build a staff around him.

Mr. McKeon, Department of Agriculture: The Institute has taken an active step in recruiting students in Agricultural Science by preparing and publishing a brochure on the profession. The Institute was also taking Agricultural Science to the undergraduate. Also an article is being published in "Juniors' Journal" to bring Agricultural Science before children and their parents.

Discussion Following Professor Wadham's Address.

Mr. L. L. Stubbs, Department of Agriculture: Asked, as Convenor of Branch Salaries and Status Sub-committee, whether the distinction made by the Professor between the research worker and the 'general practitioner' in agriculture, should be permanent.

Professor: No!

Mr. H. E. Harding, State Rivers: Could the Professor enlarge on the personality required for an extension worker? There is a great necessity for more extension workers in agriculture. A solution could be in increased recruitments from country high schools.

Professor: On the technical side, extension workers should have a knowledge of scientific principles and applications, not only so that they can talk to both scientists and farmers, but also so that they can appreciate new developments in their fields over the thirty years that follow their graduation from the University. A routine training is not enough. An extension worker should also be of an extravert type, who likes to meet people—has a sense of humour. He requires an intense knowledge of agricultural practice and 'know-how' which the University cannot give, so that he can appreciate farmers' difficulties. Farm lads should make good extension workers.

Mr. F. M. Read, Department of Agriculture: The Professor raised the question of some research work being done for the sake of teacher's own knowledge, but in practice, how can the development of a few lines of research from among the very many available be prevented? How can you prevent the excess development of a very restricted number? Is this not a danger in Australia?

Professor: One value of research work is to keep a man humble, but there can be over-concentration on a few lines because of successful teachers in those subjects. It is less risk to have this type of concentration than to have a small pedagogic approach to teaching.

Members of the Victorian Branch and visitors who attended the Symposium.

Mr. R. H. Fowler, National Museum: If the selection of research workers must be made after fourth year of the course, on what basis are they to be chosen?

Professor: The Faculty as a whole decides who is worthwhile and offers promise, but students frequently are not interested in continuing on research projects. Other schools in the University also indicate which students offer promise.

Mr. H. A. Mullett, Department of Agriculture: Stated that he had the impression that graduates had general knowledge but insufficient training in science. They could not think. How to alter this was difficult. The course was already long and he wondered if it would be possible to strengthen the scientific side by shortening the second year at Dookie. He believed that the Department could give a training on general problems and produce a balanced view but the graduate needed the basic habits of scientific thought. This is a problem deserving serious attention.

Professor: We could weed out more at examinations. Some subjects cannot aim at producing specialists, for example, plant pathology. He was worried that students should fail on a general scientific basis and asked, "What have they no capacity for?"

Mr. H. A. Mullett: They have no power to deduce—no common sense.

Professor: This is rather alarming.

Mr. B. F. McKeon, Department of Agriculture: Is any comparison between the quality of students in agriculture and other faculties available?

Professor: He believed the material available was a moderate sample—probably not as high a proportion of first-class brains as in medicine, physics and chemistry, but a better proportion in agriculture than in the other branches of science. There was a high number of casualties in first year. He considered Professor Leeper was in a better position to judge because he taught a number of composite classes, including students from a number of faculties. Professor Leeper believed that Agricultural Scientists were better than average but that the course did not get the cream of the students who went to physics and chemistry.

Mr. G. W. Gayford, Department of Agriculture: In the last issue of the Institute Journal there was a note on "Farm Surveys in Western Australia" and in the investigation of extension methods it was found that printed material was of little use to farmers. In his comment, Professor Underwood thought that this type of survey was best done by universities. Did Professor Wadham agree with this view and could he suggest what other types of surveys could be done?

Professor: The School has done surveys of this type in the past—wheat, dried fruits, dairying. The University is a suitable organisation to do this survey work, but it is very expensive. None is being done at present because nobody is interested in doing them. There is too serious a shortage of personnel available and it was better to concentrate on other type of work of a higher priority.

Mr. R. A. Mullett, Department of Agriculture: An Honors Degree in Agriculture is rated as a prerequisite to employment in some organisations. Did the Professor think this necessary?

Professor: Honors Degrees are unnecessary. Honors obtained in particular subjects in the final year should be sufficient, then a student should have a Masters Degree.

Examinations are a necessary evil but let us have as few as possible.

Mr. P. I. Pryke, Department of Agriculture: Could the Professor define the principal year in which students were ploughed?

Professor: First.

Mr. W. P. Dunk, State Rivers: Asked why it was that English Universities found the Agricultural Science degree such a popular course. Were there any lessons for Australians to learn from this?

Professor: I do not think so. With few exceptions, English degrees in agriculture are of a lower standard that we prefer to accept in Australia. They do not contain enough science.

Mr. S. Fish, Department of Agriculture: Because of the difficulties of establishing a whole range of research schools, would it not be better for Australian Universities to allot post-graduate schools between themselves? Then to get research training in a particular subject should an employer take graduates and send them to those particular schools for their research training?

Professor: I agree. We cannot offer training in every direction at every university. If you want entomology, you should go to Sydney, viticulture, perhaps to Roseworthy. The Department and C.S.I.R.O. could sometimes help more in sending students to specialised schools for further training. They have done so in the past.

Mr. H. A. Mullett: We have reached the stage in the Department where we must attract officers by scholarships to fill important gaps in our organisation. We send students to Sydney for Vet. Science, to Massey College in New Zealand and also to Melbourne. We do not know yet how to get students for post-graduate work. Mr. Fish's suggestion is a very valuable one. It should be possible to interest the Government in this regard.

Professor: There was provision for this in the original Act but the details were never worked out and they lapsed during the depression.

Dr. H. C. Forster, C.S..I.R.O.: We expect that Research Officers should show evidence of capacity to do research work, that is, possess a Masters Degree. In the intervening period between a Bachelors Degree and a Masters, C.S.I.R.O. studentships are now awarded to pass degrees to give them a further two years post-graduate work.

Dr. I. F. Phipps, I.C.I.A.N.Z.: (1) Has the Faculty any power of selection to influence the quality of students? (2) Has the Faculty ever attempted to attract students in any way, for example, by interesting rural organisations? From his own limited experience, he knew that surprisingly little thought was given to the selection of a career.

Professor: The Faculty has no power to select. There is no quota of students and he hoped there never would be. Matriculation in physics or chemistry was required because, based on experience, it was found that first year was almost impossible without them. It is very difficult to judge a prospective student. The Faculty has occasionally waived a requirement of physics or chemistry because of special circumstances such as hardship, but there have been some extreme surprises.

Discussion Following Dr. Forster's Address.

Mr. D. Angus, Meteorological Physics, C.S.I.R.O.: We know that a plant is a biological organism, that arose in a physical environment. Microclimatic conditions such as temperature, humidity, and so on immediately surrounding the plant could all influence a plant's productivity. This, to my mind, is a field well worth studying, though it is very complex. The worker would need a knowledge of the biological and physical sciences together.

Dr. Forster: I had to omit this case due to lack of time. I admit that in this the physical scientists could be of help to the biological scientists. That is why these different research workers must come togther. One other method is to try to give a physical scientist some biological appreciations. This could be done.

Mr. H. A. Mullett, Department of Agriculture: Would Dr. Forster enlarge on his ideas of interchange of personnel?

Dr. Forster: There should be increasing opportunity for C.S.I.R.O. people to go out on to the State Department's Experimental Farms, and into their laboratories—and vice versa. We have had many requests from other State Departments.

Further discussion was prevented as time was short.

Conclusion

At the conclusion of the Symposium the main points arising from the addresses and discussions were summarised by Mr. F. M. Read, of the Department of Agriculture.

In addition, Mr. Read emphasised the problem created by the shortage of trained staff and proposed the following motion for the subsequent consideration of the Victorian Branch:—

"That this Branch organize a further symposium on the recruitment and training of scientific personnel for the development and promotion of agriculture in Victoria."

Dr. I. F. Phipps seconded this motion.

EFFECTS OF MOISTURE CONTENT ON POROSITY AND AIRSPACE IN A RIVERINE CLAY UNDER IRRIGATED PASTURE

By OWEN B. WILLIAMS

Summary

Subterranean clover—Wimmera ryegrass pastures on a Riverine clay are unthrifty in the winter period, and exhibit chlorosis and red discoloration of the leaves following late autumn irrigation. Determinations of porosity and airspace in these swelling soils indicate that inadequate aeration could be the primary cause of poor growth.

Introduction

The following investigations were carried out on a clay soil (type R) at the Falkiner Memorial Field Station, Deniliquin, New South Wales. Barley (1953) has referred in some detail to the characteristics of this soil, and reviewed agronomic work in progress. The present paper is concerned with changes in porosity and airspace that occur with variation of moisture content in these swelling soils. Porosity is defined as the fraction of soil space not occupied by the solid phase. Airspace is the fraction of soil space not occupied by the solid and liquid phases.

In mid-April there is a seasonal reduction in evaporation, and rainfall reliability increases. Transpiration losses from subterranean clover (*Trifolium subterraneum* L.) and Wimmera ryegrass (*Lolium rigidum* Gaud.) pasture in its early growth stage are small, hence late autumn irrigation or winter rainfall tends to keep the soil very wet for several months. There are no immediate signs of unthriftiness in the pasture, but, by mid-July, both species are stunted and the leaves exhibit general chlorosis and red discoloration. This phenomenon cannot be attributed to low temperature, since vigorous pasture growth occurs on check banks, intensively cracked soils, and on coarse textured soils nearby. Furthermore the symptoms have been reproduced by waterlogging irrigations in early October. It was observed that in fine textured soils with poor internal drainage (type R), high moisture and low airspace values were maintained for long periods in winter, whereas in a coarse textured sandy loam with a porosity of 46.2 per cent. there was 20.5 per cent. airspace in the 0-8 cm depth four hours after a 10 cm irrigation.

The following determinations were made to test the hypothesis that inadequate aeration was responsible for poor growth during winter.

Experimental

A series of bulk density samples was taken in the 0-8 cm depth at various moisture contents using the apparatus devised by Coile (1936). These cores were considered to represent undisturbed soil. A further series of cores was taken at the same time, and transported to the laboratory where clods of 20 to 35 g were broken from each core. The density of these clods was obtained after coating with paraffin wax, by the displacement method of Johnston (1945). The soil moisture content of clod samples was determined by oven drying similar material obtained from the cores. The remainder of the core was airdried, and the density of air-dry clods was determined from this

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material. Soil moisture was determined by oven drying samples of the remaining soil material. The particle density determined by a displacement method using toluene, was 2.62 g/cc.

Results

The results are set out in the form of regressions of porosity of soil cores and of clods on moisture content (see Figure 1).

The porosity of cores increased significantly between 20 and 35 per cent. soil moisture. When the soil was drier than this gross cracking led to large errors in sampling. These obscured any porosity changes that may have occurred. There was a significant relationship between soil moisture and porosity of clods; the porosity increased from 36 per cent. at 5 per cent. soil moisture to 50 per cent. at 34 per cent. soil moisture. Swelling of the soil was responsible for these changes. As the soil becomes wet water is stored in the pores. Water is also taken up by the clay. Much of the colloidal material in soil type R is illitic and these soils contain more water and less solid per unit volume than soils in which the colloid swells less on wetting. Small cracks may be responsible for the higher porosity of cores when compared with clods at the same moisture content.

The relationship between soil moisture and airspace in cores and clods taken from 0-8 cm in soil type R is set out in Figure 2.

In both cores and clods there was a highly significant negative correlation between soil moisture and the volume occupied by air. At wilting point (20 per cent. moisture) one-third of the airspace in cores consisted of voids between the clods. At moisture contents greater than 32 per cent. cracks between clods sealed as a result of swelling and the airspace in both cores and clods fell below 10 per cent.

Discussion

It has been observed that, following irrigation, cracks in soil type R did not close completely during spring, summer or early autumn, but soil moisture under

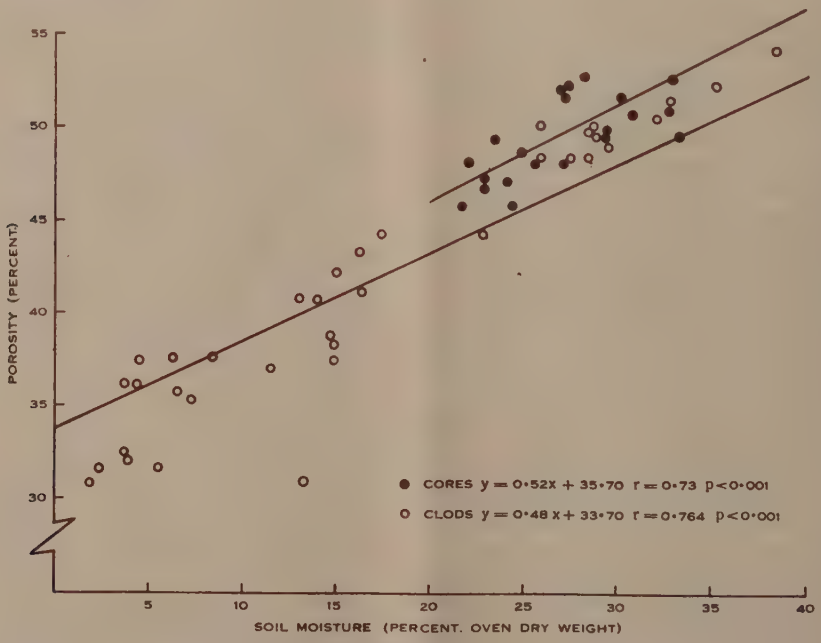

Figure 1.
Relationships between moisture content and total porosity of soil cores and clods.

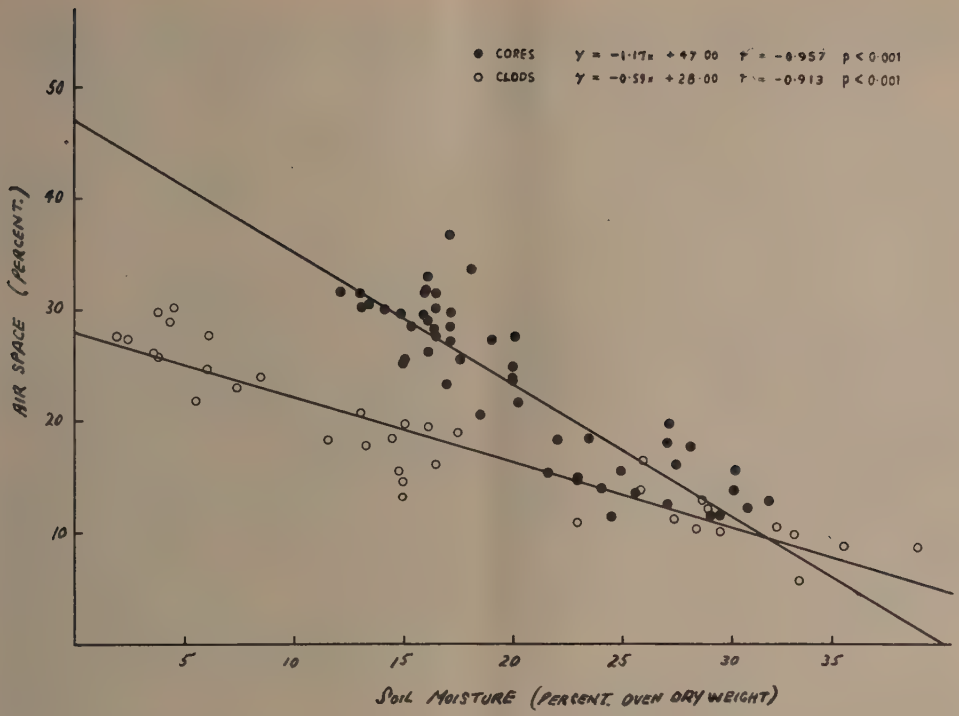

Figure 2.
Relationships between moisture content and airspace in soil cores and clods.

these conditions seldom reached 32 per cent. However, during winter, soil moisture values exceeding 32 per cent. were found in the 0-8 cm layer and the experimental data show that at these values the airspace is reduced to below 10 per cent. It seems highly probable therefore that inadequate aeration is responsible for the poor winter growth of irrigated pastures on soil type R. The rapid recovery of the pasture in early spring might be attributed to increased air supply following more rapid evaporation and transpiration.

It was calculated for the 0-8 cm depth of soil type R that a reduction in soil moisture from 32 per cent. to 27 per cent. will cause an increase in the exposed surfaces of the soil of 80 to 100 per cent. This increase in surface area leads to an almost proportional increase in water penetration, neglecting the volume of water required to fill the cracks. In this way the intensity of the cracking pattern can offset to some extent the inherent low permeability of uncultivated soil.

Two methods might be used to reduce the likelihood of inadequate aeration limiting growth of irrigated pasture. Either the period of inadequate aeration could be reduced by avoiding excessive irrigation as winter approaches, or alternatively, the effects of poor aeration might be avoided by the establishment and growth of species which possess some degree of hydrophytism (Prunster 1950).

References

Barley, K. P. (1953)—*J. Aust. Inst. Agric. Sci.*, 19: 99.

Coile, T. S. (1936)—*Soil Sci.*, 42: 139.

Johnston, J. R. (1945)—*Soil Sci.*, 59: 277.

Prunster, R. W. (1950)—Pasture development in the great area of the Riverina. Paper presented to C.S.I.R.O. Advisory Council 2nd Session.

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LEGUME NUTRITION ON RED BASALTIC SOILS OF THE RICHMOND RIVER DISTRICT OF NEW SOUTH WALES

By F. C. CROFTS, J. S. PULSFORD and H. V. JENKINS

Summary

In factorial legume nutrition experiments conducted during 1951 and 1952 on the Wollongbar series of the red basaltic soils of the Richmond River district of New South Wales, large responses in clover growth were obtained from dressings of sodium dihydrogen phosphate while potassium chloride and calcium carbonate each significantly increased clover yields.

No significant responses were obtained to any of the trace elements applied, although the effects of sodium molybdate and zinc sulphate, separately and in combination, approached significance.

Superphosphate gave large responses in clover growth while heavy dressings of lime or dolomite gave small but significant yield increases.

Introduction

The general agronomic problems of the red basaltic soils of the Richmond River district, the largest butter producing area in New South Wales, have been defined by Breakwell and Jenkins (1951). The growth of the legume deficient paspalum (*Paspalum dilatatum* Poir) pastures has become severely limited by a deficiency of available soil nitrogen, resulting in a marked decline in dairy production.

The incorporation of legumes in the existing pastures was suggested by Breakwell and Jenkins (1951) as the most practical method of increasing pasture and dairy production.

Analytical studies on these soils have revealed that they are very acid, highly unsaturated, low in all bases except sodium, but high in free ferric oxide, unavailable phosphorus and organic matter (Parbery 1939; Prescott and Hosking 1936; Nicolls, Colwell and Tucker 1953).

The field plot investigations described in this paper were designed to determine which nutrient elements are deficient for clover growth on these soils.

Experimental

General

The experiments were conducted during 1951 and 1952 at Wollongbar, on a paddock which had been intensively cropped and grazed since about 1870 without the use of fertilisers.

This particular soil has been described as the Wollongbar series of the red basaltic soils by Nicolls, Colwell and Tucker (1953) and is believed to be representative of a large proportion of the 200,000 acres of Krasnozems within the Lismore-Ballina-Bangalow triangle.

A pH uniformity test was conducted over the experimental area just prior to planting on a well prepared seedbed in April, 1951. Surface soil samples gave pH readings from pH 4.4 to 4.8 on a glass electrode with the soil at the sticky point.

In 1951 the Montgomery strain of red clover (*Trifolium pratense* L.) at 15 lb/ac was sown in each 15 link square plot with the appropriate fertiliser mixture, using damp sawdust as a spreader.

For the 1952 sowings the seed mixture used was Mt. Barker subterranean clover (*Trifolium subterraneum* L.) at 9 lb/ac; crimson clover (*T. incarnatum* L.) at 4 lb/ac; and New Zealand certified broadleaf red clover at 2 lb/ac.

All the clover seed was inoculated with a rhizobial strain identified as 295 at the University of Sydney, because it was then believed that this strain would be effective on all three clovers.

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The 1953 sowings were made in late March and the 1952 fertiliser treatments were repeated in all plots.

By late May the subterranean and crimson clover plants showed symptoms of nitrogen deficiency due to ineffective nodulation and evidence from other experiments being conducted simultaneously (Jenkins, Vincent and Waters, 1954) showed that strain 295 was ineffective in these soils while Sydney University strain 298 was effective on both subterranean and crimson clovers.

On June 10, a suspension of rhizobial strain 298 was watered onto half of each plot in one replicate of each experiment and the effect of the inoculum became evident towards the end of August, when the nitrogen deficiency symptoms disappeared and the plants displayed effective nodules.

Dry matter yield from each plot was estimated by cutting two 35.1 x 17.6 inch quadrats of clover from the effectively nodulated side of the plot and determining the dry matter yield.

Details of Experiments

Experiment No. 1, to test the effect of the five major elements phosphorus, magnesium, calcium, potassium and sulphur, alone and in combination, on clover growth.

A twice replicated 2^5 factorial design with confounding and randomisation was used.

Phosphorus was applied as $NaH_2PO_4.H_2O$ B.P.; magnesium as $MgCO_3$ B.P.; calcium as $CaCO_3$ B.P.; sulphur as Na_2SO_4 B.P.; and potassium as KCl B.P. The rates of application of phosphorus and sulphur were equivalent to 22% superphosphate at 4 cwt/ac. Calcium and magnesium were applied at rates equivalent to dolomite (with 18% MgO and 21% CaO) at 4 cwt/ac. Potassium was applied as KCl B.P. at 1 cwt/ac.

A basal dressing of $CuSO_4.5H_2O$ B.P. at 10 lb/ac, $ZnSO_4.7H_2O$ B.P. at 10 lb/ac, and $NaMoO_4.2H_2O$ A.R. at 2 oz/ac was applied to all plots to overcome possible deficiencies of copper, zinc and molybdenum.

Experiment No. 2, to test the effect of the minor elements copper, zinc, molybdenum, and the group: manganese plus iron plus boron, alone and in all possible combinations, on clover growth.

A twice replicated 2^4 factorial design with confounding and randomisation was used.

The elements copper, zinc, and molybdenum were applied as the same chemicals and at the same rates as in experiment 1. The group: manganese plus iron plus boron was supplied as $MnSO_4.4H_2O$ B.P. at 28 lb/ac, $FeSO_4.7H_2O$ B.P. at 56 lb/ac, and H_3BO_3 at 7 lb/ac.

A basal dressing of $CaCO_3$ commercial and $NaH_2PO_4.H_2O$ B.P., equivalent respectively to calcium and phosphorus in 22% superphosphate at 4 cwt/ac, together with K_2SO_4 commercial at 2 cwt/ac, was applied to all plots.

Experiment No. 3, to test the effect of superphosphate or nil; dolomite, lime, or nil; copper plus zinc plus molybdenum or nil; alone or in combination, on clover growth.

A twice replicated 2 x 3 x 2 factorial design was used.

The superphosphate, containing 22% P_2O_5, was applied at 4 cwt/ac while dolomite, containing 21% CaO and 18% MgO; and lime, containing 55% CaO; were each applied at 2 ton/ac. The copper, zinc, and molybdenum were applied as the same chemicals and at the same rates as in experiments 1 and 2.

Results

Owing to late planting and a severe drought, no quantitative yield data were obtained in 1951. Responses were observed to sodium dihydrogen phosphate in experiment 1 and to superphosphate in experiment 3.

Summaries of the yield data obtained in 1952 from the half plots treated with rhizobial strain 298 are presented in Tables I, II and III.

TABLE I.

Effect of major elements on the oven dry yield of clover in effectively nodulated half plots.

(Mean yield per plot was 26.4 cwt/ac at harvest made September 10, 1952, and 38.9 cwt/ac at November 20, 1952).

Treatment	Mean response in cwt/ac	
	Harvest September 10, 1952	Harvest November 20, 1952
P	+ 16.7	+ 27.0
Mg	+ 1.7	+ 0.1
Ca	+ 2.7	+ 6.0
K	+ 4.4	+ 6.2
S	+ 1.0	— 1.1
Significant response $P < 0.05$	± 3.06	± 4.22

In the major elements experiment 1, the response to phosphorus was large, being an average of 16.7 cwt/ac at the first harvest and 27.0 cwt/ac at the second harvest. Potassium gave small significant responses at both harvests. Calcium gave a significant response only at the second harvest. Magnesium and sulphur failed to give significant responses at either harvest. There were no significant interactions between elements.

In the minor elements experiment 2, no element or combination of elements significantly increased clover yield but the responses due individually to zinc and molybdenum approached significance as shown in Table II. There were no significant interactions between elements.

In the commercial fertilisers experiment 3, superphosphate gave large average responses at both harvests. Lime or dolomite gave small but significant responses, and when applied with superphosphate, equally increased the yields of clover at both harvests. The minor element group copper plus zinc plus molybdenum did not affect yields.

Discussion

The large response obtained to phosphorus was in close agreement with the results obtained by Anderson and Arnot (1953) from pot culture studies on these soils. The clover plants showed a marked response to added phosphorus throughout the whole growing season.

Parbery (1939a, 1939b) from laboratory studies, found, after mixing various amounts of superphosphate with red soil, that the amount of phosphorus which could be recovered after seven days by extracting with 1 per cent. citric acid was negative or very small; even when superphosphate dressings considerably in excess of field applications were used. A similar high rate of phosphorus fixation by these soils has been suggested by Nicolls, Colwell, and Tucker (1953).

The results of this experiment and those of Anderson and Arnot (1953) in pots, indicate that the rate of phosphorus fixation in the field is very much lower than that determined from laboratory

TABLE II.

Effect of minor elements on the oven dry yield of clover in effectively nodulated half plots.

(Mean yield per plot was 18.7 cwt/ac at harvest made August 8, 1952, and 49.2 cwt/ac at October 17, 1952).

Treatment	Mean response in cwt/ac	
	Harvest August 8, 1952	Harvest October 17, 1952
Cu	— 0.2	— 2.8
Zn	+ 0.2	+ 7.9
Mo	+ 2.0	+ 8.2
Mn+Fe+B	+ 0.9	— 1.5
Significant response $P < 0.05$	± 3.88	± 8.38

TABLE III.

Effect of commercial fertilisers on the oven dry yield of clover in effectively nodulated half plots.

(Mean yield per plot was 17.4 cwt/ac at harvest made August 4, 1952, and 40.0 cwt/ac at October 15, 1952).

Treatment	Mean response in cwt/ac	
	Harvest August 4, 1952	Harvest October 15, 1952
Superphosphate	+ 11.6	+ 18.1
Cu+Zn+Mo	+ 0.7	— 1.7
Dolomite	+ 6.7	+ 7.9
Lime	+10.2	+ 8.7
Significant response Superphosphate or Cu+Zn+Mo.P<0.05	± 4.24	± 7.1
Lime or dolomite P<0.05	± 5.2	± 8.68

studies, and that applications of superphosphate are likely to be highly economical provided other deficiencies are not limiting plant growth.

The lack of response to magnesium applied as magnesium carbonate was not unexpected. Although Parbery (1939b) considered from analytical studies that a magnesium deficiency was likely, Nicolls, Colwell, and Tucker (1953) calculated that in 60 years of dairying only about 10 lb of magnesium ion per acre would be removed in milk and that it may be many more years before such a deficiency becomes apparent. Anderson and Arnot (1953) obtained a response to magnesium sulphate only in the absence of potassium sulphate, indicating that elements other than magnesium might be involved.

Parbery (1939b) has shown that these soils are low in calcium but Nicolls, Colwell, and Tucker (1953) found that 60 years of dairying would remove only about 120 lb of calcium ion per acre in milk. The small response to light dressings of calcium carbonate, obtained only at the second harvest, would indicate that a deficiency of this element is not critical. It is likely that any calcium deficiencies on these soils would be adequately corrected by the calcium applied when superphosphate is used to remedy phosphorus deficiency.

The response to potassium is in accordance with the analytical work of Parbery (1939b) who found many samples of this soil to be deficient. Nicolls, Colwell, and Tucker (1953) calculated that, in 60 years of dairying, about 150 lb of potassium ion per acre had been removed in milk and this quantity is nearly as much as now remains in an exchangeable form in the surface four inches of an average sample of Wollongbar clay loam. With this relatively high rate of removal, compared with the quantity which remains, widespread deficiencies of this element are likely.

The lack of response to sulphur applied as sodium sulphate does not support the findings in pots by Anderson and Arnot (1953) who reported a small response to sulphur. The experimental area was cultivated and fallowed before being sown and several workers (Andrew, Kipps, and Barford, 1952; Anderson 1952; Hilder 1954) report lack of sulphur responses on sulphur deficient soils after cultivation and fallow. Furthermore, all plots in this experiment received basal dressings of copper and zinc sulphates in each year and these may have satisfied the possible sulphur deficiency.

Of the minor elements only zinc and molybdenum gave responses which approached significance. Anderson and Arnot (1953) reported a small response to molybdenum and Arthur (1951) from an unreplicated field experiment on a similar but more severely exploited soil at Dunoon, reported large responses to both molybdenum and zinc. Nicolls, Colwell, and Tucker (1953) have suggested that the minor elements in these soils tend to be concentrated in the top

six inches of the profile, so that deficiencies of zinc and molybdenum are more likely to occur on land where the top soil has been eroded away.

When either dolomite or lime was applied in two successive annual dressings of two tons per acre, it slightly increased the clover yield. The effect was possibly due to the materials increasing the rate of nitrification of the soil organic matter as described by Parbery (1945; 1946). Such a use of these materials on these soils is clearly uneconomic.

Acknowledgment

The authors are indebted to Mrs. I. Boots for the use of the land on which these experiments were conducted. They also wish to acknowledge assistance given by Mr. E. J. Breakwell and Mr. J. M. Vincent of the University of Sydney; Mr. F. C. McCleary and Mr. G. Giles of the New South Wales Department of Agriculture, and Dr. J. G. Davies, Mr. C. M. Donald and Mr. A. J. Anderson of C.S.I.R.O.

References

Anderson, A. J. (1952)—The significance of sulphur in Australian soils. *J. Aust. Inst. Agric. Sci.*, **18**: 135-39.

Anderson, A. J., and Arnot, R. H. (1953)—Fertiliser studies on basaltic red loam soil from the Lismore district of N.S.W. *Aust. J. Agric. Res.*, **4**: 29-43.

Andrew, C. S., Kipps, E. A., and Barford, H. (1952)—Responses to nitrogen and sulphur on heavy clay soils from Darling Downs, South-east Queensland. *Aust. J. Agric. Res.*, **3**: 111-24.

Arthur, J. (1951)—Minor elements on pastures in the Lismore district. *Agric. Gaz. N.S.W.*, **62**: 589-96.

Breakwell, E. J., and Jenkins, H. V. (1951)—Some aspects of pasture improvement in the Richmond river district of N.S.W. Proc. Aust. Agrost. Conf., Canberra, 1951.

Hilder, E. J. (1954)—Some aspects of sulphur as a nutrient for pastures in New England soils. *Aust. J. Agric. Res.*, **5**: 39-54.

Jenkins, H. V., Vincent, J. M., and Waters, Lawrie M. (1954)—The root-nodule bacteria as factors in clover establishment in the red basaltic soils of the Lismore district, N.S.W. *Aust. J. Agric. Res.*, **5**: 77-89.

Nicolls, K. D., Colwell, J. D., and Tucker, B. M. (1953)—A survey of soils and some aspects of soil fertility in the Lismore district of N.S.W. Soils and land use series No. 11, Div. of Soils, C.S.I.R.O., Aust.

Parbery, N. H. (1939a)—The basaltic and associated soils of the Tweed river and Richmond river districts, and the Dorrigo, Comboyne and Robertson plateaux of N.S.W. Thesis, Univ. Sydney.

Parbery, N. H. (1939b)—The basaltic and associated soils of the far north coast districts of N.S.W. Dept. Agric. N.S.W. Regional Soil Ser. No. 2.

Parbery, N. H. (1945)—The effect of dolomite on nitrification in strongly acid red basaltic soils. *Agric Gaz. N.S.W.*, **56**: 543-44.

Parbery, N. H. (1946)—The problem of declining fertility in red laterite soils. *Agric. Gaz. N.S.W.*, **57**: 291-97.

Prescott, J. A., and Hosking, J. S. (1936)—Some red basaltic soils from eastern Australia. *Trans. Roy. Soc. S. Aust.*, **60**: 35-45.

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BOOK REVIEWS

THE WHITE MAN'S DILEMMA

By JOHN BOYD ORR

(*Published by George Allen & Unwin Ltd., London*, 1953: *Angus & Robertson*, 15/9.)

The white man's dilemma whether to employ "The Big Machine" on arming power politics, in which case his civilisation might be destroyed, or on raising the standard of living and education of the natives of Asia and Africa, in which case the supremacy he has gained in the last three hundred years will be lost.

Lord Boyd Orr draws on his experience as Director General of the Food and Agriculture Organisation to describe how close F.A.O. came, in its negotiations with governments, to becoming the nucleus of a limited supra-national power. Food is our common interest and Lord Boyd Orr outlines the steps towards progress beyond the point at which F.A.O. was halted, towards doubling the world's food supply in the next generation.

THE DISTRIBUTION AND ABUNDANCE OF ANIMALS

By H. G. ANDREWARTHA and L. C. BIRCH

(*University of Chicago Press, Chicago, Illinois*, 1954; *xv* + 782 *pp.*, $15.00.)

In devising methods for the control of our more serious agricultural pests, applied entomologists in Australia now recognise the importance of acquiring a detailed knowledge of their ecology. Although much valuable work in this field has already been done, there is abundant scope for original ecological research on most of our animal pests. In recent years several text books have appeared which review a tremendous volume of relevant ecological literature. Andrewartha and Birch have now analysed the data contained in many of the more important papers and developed from them a general theory to explain the natural distribution and abundance of animals.

In writing this stimulating treatise, the authors have departed from the more conventional analysis of ecological communities and have drawn upon data derived from the study of individual animal species. Throughout the work they seek to establish the thesis that "distribution and abundance are merely different aspects of the same phenomenon" which they explain in terms of the natural environment of the individuals comprising the population. The chance of survival of the individual animal is not necessarily "density dependent" and should not be ascribed to intra-specific competition. The population has little significance as an entity in ecology. For clarity of understanding it is necessary to think in terms of the environment of the individual.

The authors consider that there are four components of environment which determine the distribution and abundance of individuals. They are weather, food, other animals including those organisms causing disease, and a place in which to live. They conclude that a shortage of material resources, such as food, is probably the least important way in which the numbers of animals in natural populations are limited. Of major importance is the length of time when the actual rate of increase is positive. Fluctuations in the actual rate of increase may be caused by weather, predators or any other component of environment which influences this rate.

This theory of animal ecology will by no means meet with general approval among ecologists, but in featuring what they consider to be weaknesses in other theoretical studies, the authors have made a substantial contribution to our knowledge in this field. The work is clearly not intended as a text book of animal ecology, though the student will find there a wealth of ecological information, critically evaluated. Many of the papers which have received the most detailed treatment are on Australian insects and therefore have a special interest to workers in this country. The authors are ecologists of high repute with a penetrating knowledge of applied ecology derived from many years of research at the Waite Agricultural Research Institute and the University of Sydney.

Many readers will find the very detailed treatment of the physiological aspects of ecology and the extensive analyses of the various components of the environment tedious in a treatise designed primarily to develop a general theory of animal ecology. Diapause, for example, though of considerable importance in insect ecology, has only recently been reviewed at length by Andrewartha and its relevant aspects could therefore have been summarized more briefly. Greater brevity too in summarizing much of the experimental data reviewed would have assisted the reader in grasping the broader principles the authors seek to establish. On the other hand, those who find the theoretical interpretation unacceptable will no doubt consider the critical review of the literature sufficient justification for recommending this book to all serious students of ecology.

I. F. B. COMMON.

BOOK LIST

Notice has been received that the following books on agricultural topics have been published recently:—

FEATHERLY, H. I.—Taxonomic terminology of the higher plants. *Ames, Iowa State College Press*, 1954, $3.75.

FRYER, H. C.—Elements of statistics. *N.Y., John Wiley and Sons Inc.*, 1954, $4.75.

JOHNSON, V. Webster and BARLOW, Raleigh.—Land problems and policies. *N.Y., McGraw-Hill Book Co.*, 1954, $6.50.

TECHNICAL NOTES

PHTHALEINCOMPLEXONE AS AN INDICATOR FOR CALCIUM AND MAGNESIUM IN THE TITRATION OF SOIL EXTRACTS

The sum of exchangeable calcium plus magnesium in extracts of soil samples may be determined by titration with disodium ethylenediaminetetraacetate (EDTA) using eriochrome black T as an indicator for magnesium. This titration may often be carried out without preliminary separation from the replacing salt. Unfortunately traces of copper, cobalt, etc., give coloured complexes with eriochrome black T which are not decomposed by EDTA and in addition manganese leads to oxidation of the indicator.

Anderegg *et al.* (1954) have developed a new indicator, phthaleincomplexone, which is very sensitive to alkaline earth and magnesium ions and which is not affected by these other metals. Phthaleincomplexone is made by condensing 2 moles of iminodiacetic acid with 1 mole of o-cresolphthalein by means of 2 moles of formaldehyde. It is a hydrogen-ion indicator being colourless below pH 6.5 and changing to a pale pink between pH 7 and 8. Above pH 11 it becomes an intense red-violet. Between pH 10 and 11, calcium, strontium and barium give red to violet colours and magnesium gives a deep pink colour. For these reasons it is a more useful indicator than eriochrome black T.

Although metals such as copper do not affect the endpoint with phthaleincomplexone they are nevertheless chelated more strongly by EDTA than are calcium and magnesium, and will therefore be included in the titre. If they are present in amounts which are unknown or cannot be ignored, they should be complexed with cyanide in the same way as when eriochrome black T is being used.

As an alternative to eriochrome black T in the titration of calcium plus magnesium or of barium after the precipitation of sulphate by methods like that of Munger, Nippler and Ingols (1950), phthaleincomplexone has given excellent results and its use can be strongly recommended. Similar methods to those employing eriochrome black T can be used, but magnesium need not and should not be added to solutions which do not contain it. The sensitivity to barium and strontium is greatest towards pH 11 and, if magnesium is absent or has been chelated, more ammonia can be added if greater sensitivity is desired. But if ammonium salts are not present, ammonia will react with sodium and potassium salts to give the alkaline colour of phthaleincomplexone.

Phthaleincomplexone is exceedingly sensitive in pure calcium solutions and is useful for checking the normality of solutions of EDTA or other chelating reagents. The sensitivity to magnesium ions or in the presence of ammonium salts is less and some warning of the approach of the endpoint is given—otherwise the abruptness of the colour change may cause difficulty in unknown solutions.

The colour change is from a violet-red to a pale pink. Anderegg *et al.* recommend masking the residual pink with a mixture of methyl red and diamine green B: the colour change is then from violet to a pale grey (practically colourless). The aqueous solution of phthaleincom-

plexone however is not stable for more than a few days; this difficulty is avoided by making the indicator-dye mixture in ammonium chloride powder. Naphthol green B is better than the mixture of diamine green B and methyl red since it is more easily soluble in water than diamine green B and needs no methyl red to make it compensate for the residual pink of the phthaleincomplexone.

The residual pink colour is enhanced in solutions of ammonium chloride and acetate. By using slightly more naphthol green B than is necessary to compensate for the residual pink in ammonium salt solutions the colour change at the endpoint is from violet through a pale grey to a pale green. The grey endpoint colour can be judged quite precisely in ammonium salt solutions at about half-normal concentration (which should be the maximum concentration at the end of a titration of exchangeable calcium plus magnesium). In water solutions the grey colour appears only at a sharply-defined point and the appearance of a green colour indicates a slight over-titration. Using EDTA or the stronger chelating agent cyclohexanediaminetetraacetic acid (Schwarzenbach *et al.*, 1954) the reproducibility of the titre is limited not so much by the sharpness of the colour-change as by manipulative errors (or by the reliability of the sulphate precipitation).

For the determination of sulphate it is preferable to remove ammonium salts since they reduce not only the sensitivity of phthaleincomplexone to barium but also the reliability of the sulphate precipitation.

As with eriochrome black T, the test solution has to be brought to pH 10-10.5: at greater alkalinities magnesium hydroxide may precipitate. A suitable buffer consists of one volume of 25 per cent. ammonia solution and two volumes of normal ammonium chloride—one ml is required for each 10 ml of neutral test solution. For ammonium salt extracts of soils the same proportions are used, viz. 5 ml of 25 per cent ammonia for each 10 ml of normal ammonium solution.

Phthaleincomplexone Indicator Powder

Grind 20 g of pure ammonium chloride in a glass mortar until the bulk will pass an 80-mesh sieve. Pass the powder through a 120-mesh sieve. Grind 100 mg of phthaleincomplexone and 75 mg of naphthol green B into successive small portions of the finest powder until it all passes the 120-mesh sieve. Mix all of the portions of the powder together and store in a jar fitted with a drying tube containing coarse silica gel. About 40 mg of the mixture is required for each titration.

Acknowledgment

Samples of phthaleincomplexone and cyclohexane-1 : 2-diamine tetraacetic acid were kindly supplied by A-G vorm. B. Siegfried of Zofingen, Switzerland.

References

Anderegg, G., Flaschka, H., Sallmann, R., and Schwarzenbach, G. (1954)—Metallindikatoren VII. Ein auf Erdalkaliionen ansprechendes Phtalein und seine analytische Verwendung. *Helvetica Chimica Acta*, 37: 113.

Munger, J. R., Nippler, R. W. and Ingols, R. S. (1950)—Volumetric determination of sulfate ion, *Analytical Chemistry* 22 : 1455.

Schwarzenbach, G., Gut, R. and Anderegg, G. (1954).—Komplexone XXV. Die polarographische Untersuchung von Austauschgleichgewichten, Neue Daten der Bildungskonstanten von Metallkomplexen der Athylendiamin-tetraessigsäure und der 1, 2-Diamino cyclohexan-tetraessigsäure. *Helvetica Chimica Acta*, 37: 937.

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DEEP PLACEMENT OF RHIZOBIAL CULTURES AS AN AID TO LEGUME INOCULATION

To minimise the wastage of seed of new strains of small seeded legumes it is essential to have satisfactory establishment in the year of sowing. At the Merredin Research Station the growth of subterranean clover (*Trifolium subterraneum*) in trials on a lateritic sandplain soil (Wodgil type) has been adversely affected by a number of the plants turning red and making little or no growth. Examination of the affected plants has usually shown that they have failed to nodulate. These soils are of relatively low inherent fertility with a pH range of 5.4 to 5.5.

A trial was laid down in the autumn of 1954 to test the effect of deep placement of the rhizobial inoculum on ten legumes, namely:—

(1) Four strains of subterranean clover—Dwalganup, Yarloop, and the crossbreds (Red Leaf x Dwalganup) 815.123.2 and 898.56,

(2) Four species of medic — barrel (*Medicago tribuloides*), snail (*M. scutellata*), goldfields (*M. minima*) and burr (*M. denticulata*),

(3) Woolly clover (*T. tomentosum*) and

(4) clustered clover (*T. glomeratum*).

The land used for the experiment had been cleared for fifty years and had been cropped on ten occasions since 1911.

Experimental Procedure

Superphosphate at the rate of 1 cwt/ac plus the appropriate dressings of the trace elements copper, zinc and molybdenum were chipped into the soil before the opening rain. After a good germination of winter weeds had been obtained the land was hoed to a depth of three inches and this had the effect of air drying the surface soil. In the case of the deep placement plots, the rows were opened to a depth of 3 inches and a suspension of the appropriate rhizobia sprinkled on the bottom of the trench and covered immediately.

On June 2, 1954, the seed was sown in the row without artificial inoculation to give an effective planting depth of about one inch. The seeds of the control plots were inoculated with the same suspensions and sown immediately in trenches one inch deep.

The weather during the three weeks following planting was extremely dry and only 54 points were recorded in five falls which occurred at the end of June. Irregular germination occurred in late June and early July. During the last two weeks of July 220 points of rain fell.

An initial sampling was made on July 20, and it was found that although there was little top growth the roots of most species had penetrated to a depth of three inches without appreciable lateral branching.

All the plots were sampled at the end of September to a depth of five inches better growth, while the nodule development beyond 3-4 inches. The plants from "deep placement" plots could be distinguished in most instances by their better growth, while the nodule development was mostly at 2-3 inches as compared with 1-2 inches in the controls. The yield of tops was significantly greater from the "deep placement" plots.

Conclusion

While many factors can result in subclover failing to nodulate in the first year on West Australian sandplain soils it appears that deep placement of the inoculum using either a powder or liquid form may be beneficial under some cir-

cumstances. The normal method of shallow planting of both seed and inoculum may result in heavy rhizobial mortality, particularly when, due to dry weather, the tap root does not initiate many branches but grows down. It is possible that under such unfavourable conditions a modified drill to give deep placement of rhizobial dust or liquid cultures would be advantageous. This would result in a three level distribution as follows: $\frac{1}{2}$-1 inch deep, seed; 2-3 inches, superphosphate and trace elements; 3-4 inches, rhizobial inoculum.

In view of the findings of Andrew and Milligan (1954) at Wagga, it is of interest to note that good nodulation of the medics was obtained despite the low pH of 5.5. The extent to which this was due to the use of a molybdenum fertiliser is not known.

Acknowledgment

The author would like to thank Mr. D. P. Drover for making the pH determinations and Mr. C. A. Parker for helpful discussions. He would also like to acknowledge the help and interest of the Director of the Institute of Agriculture, Professor E. J. Underwood.

References

Andrew, and Milligan (1954)—*J. Aust. Inst. Agric. Sci.* **20**: 1954.

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(*Received for publication February* 22, 1955).

CORRELATION OF CLEAN SCOURED YIELD OF MID-SIDE AND WHOLE FLEECE WOOL SAMPLES

Clean scoured yields of a set of 20 Queensland Merino 66's unskirted fleeces free from vegetable contaminant have been recently compared with those of the samples drawn from the mid-side (6 inches from the dorsal line and 3 inches behind the heart girth). The yields were calculated by a comparison of the original air-dry weight and the clean scoured dry weight in an air oven at 103-5°C.

A correlation coefficient of 0.683 indicated high positive correlation and is supporting evidence for the development in testing practice of relying on the mid-side sample as an indication of whole fleece yield.

There is obviously an advantage, both technically and commercially, in being able to obtain an accurate value from a small sample instead of having to test the whole fleece.

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(*Received for publication March* 8, 1955).

BLUE MOULD OF TOBACCO

I—WEEDS IN RELATION TO DISEASE PERCENTAGES IN YOUNG TRANSPLANTS

Summary

Observations on young tobacco transplants showed that the percentage of plants with blue mould was higher in rows that had been left unhoed than in rows that had been hoed. The higher incidence was associated with the growth of weeds close to the tobacco plants.

Introduction

Great variation in the incidence of blue mould (*Peronospora tabacina* Adam) of tobacco (*Nicotiana tabacum* L.) in adjacent fields was observed by the authors independently in the Ovens River and Gunbower districts of Victoria and in the lower Burdekin area of Queensland. This variation was observed not only between fields but also within fields.

Although the spread of blue mould is generally accepted as determined by weather conditions, the variation within fields led us to look for other factors which influenced it.

Some of these differences were associated with plant age and vigour, the larger plants, which had been exposed to infection for a longer period than younger transplants, showing the higher incidence of the disease. In some fields the patchy distribution was associated with microtopography and in one field with a difference in soil texture. As a general rule disease-free seedlings from beds treated with benzol were planted, but in some fields high incidence of the disease could be traced to infection in improperly managed beds.

Observations

In November, 1954, the writers inspected a field in the Ovens River Valley, Victoria, where hand hoeing had been discontinued when the soil became sticky during wet weather. The soil around the plants in the hoed parts of the field was in a broken condition with a small clod size and was free of weeds. The unhoed soil was caked and there was a heavy cover of weeds, chiefly Yorkshire fog grass (*Holcus lanatus* L.). After hoeing was stopped these weeds developed for 10 days before the plants infected with blue mould were counted. 171 points of rain fell during the first six of these days. The plants showing blue mould symptoms in four random groups of 50 plants in the hoed and unhoed portions of the field were counted. Twenty per cent. of the plants in the unhoed portion were infected, but only 13 per cent. in the hoed portion. On the following morning infected plants in the four rows immediately adjacent to each other (two on each side of the division) were counted. In all, sixteen groups of fifty plants were examined in the two hoed rows and the same number in the two unhoed rows. There were 51 per cent. infected plants in the unhoed, compared with only 31 per cent. in the hoed portion.

In the course of the survey seven other fields were found in which hoeing had been stopped within a group of plants of the same age and variety when wet weather set in. The incidence of blue mould in the hoed and unhoed portions is shown in Table I.

Altogether 3,300 plants were counted in the unhoed portion and the same number in the hoed portion, the numbers of plants with visible symptoms of blue mould being 1,330 and 809 respectively. This difference was significant at $p < 0.001$.

Discussion

Comparisons between hoed and unhoed rows could be made only in eight fields, because in other fields hoeing had either been completed before the rain or neglected entirely. In other fields with weedy rows the incidence of blue mould

TABLE I.

Numbers of Plants with Visible Symptoms of Blue Mould in Hoed and Unhoed Rows of Tobacco Fields.

Field	No. of plants counted in each section	Percentage of diseased plants in hoed rows	Percentage of diseased plants in unhoed rows	Special features of field
A	1,000	27.5	45.0	Weeds tall; mainly *Holcus lanatus* L.
B	300	38.3	67.7	Weeds sparser than in field A.
C	500	38.4	65.6	Weeds mainly dicotyledonous species.
D	200	22.5	40.5	Disease more concentrated on higher end of field.
E	200	27.5	23.0	The unhoed portion practically free from weeds.
F	800	3.6	8.0	In Gapsted area, weeds sparse.
G	200	44.5	76.0	In Gapsted area, heavy growth of dicotyledonous weeds.
H	100	9.0	16.0	In Markwood area.
Total	3,300	14.5	39.6	

The difference between the hoed and unhoed rows is significant at the $p < .001$ level.

was higher and the symptoms on individual plants were more severe than in fields free from weeds. One exception was found. The exception was a weedy field with a low incidence of blue mould, tobacco being grown for the third successive year. The seedlings recovered quickly after transplanting into the well-drained soil and grew rapidly thereafter. Infected plants were confined to an area of a few square yards in a low-lying part of the field.

The weed flora differed from field to field, in many fields grasses being the most common species. In other fields the weeds were almost entirely dicotyledonous species, including *Datura stramonium* L., *Polygonum aviculare* L., *Chenopodium album* L., *Raphanus raphanistrum* L., *Urtica* sp. and *Rumex* spp.

The lower incidence of blue mould in hoed rows may have been due either to the reduction in the number of weeds or to the loosening of the soil adjacent to the tobacco plants. The fact that in the one field where the unhoed rows were virtually free from weeds (field E in Table I) there were more diseased plants in the hoed than in the unhoed rows suggests that the higher incidence in other fields could be ascribed to the presence of weeds

close to the plants. The weeds may have delayed the drying of dew and rain, thus favouring germination of airborne spores of the pathogen and establishment of mycelium in the host plant. The reduction of blue mould infection in young transplants would be expected to result in fewer diseased mature plants if the weather became fine and sunny following a short period of active spread of blue mould. If weather favourable to the spread of the disease continued, all plants would probably become infected later in the season. This appears to be the first time that weeds (other than alternate hosts) in the immediate environment have been demonstrated to influence percentages of an air-borne plant disease.

Acknowledgments

The authors are thankful to Mr. G. A. McIntyre for statistical analysis of the data and to those growers who are assisting in the blue mould survey by allowing their fields to be inspected frequently during the tobacco season.

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(Received for publication, March 1, 1955).

A DISBUNCHING EXPERIMENT ON THE SULTANA

Antcliff and Webster (1955), after surveying the distribution of fruitful buds on the sultana, found a correlation between the crop matured in one season and the percentage of fruitful buds formed for the following season. Thomas and Barnard (1937) also mention current season's crop as a factor influencing the formation of fruitful buds, and describe an experiment in which complete disbunching in November was followed by significant increase in yield in the next two seasons.

This note describes an experiment at the Commonwealth Research Station, Merbein, in which vines were disbunched at intervals during the 1949-50 season, and the effect on the vines in the following season observed. Fruitfulness was very high in 1949-50, and this season should therefore have been very suitable for commencing such an experiment. There were five treatments:—complete disbunching on November 17 (A), December 15 (B), January 16 (C), February 14 (D), and no disbunching (E). It had been intended to make treatment E complete disbunching on March 16, about the normal picking date, but by this time the fruit was too mouldy, following rain damage, to be worth picking. The treatments were applied to single vines in seven adjacent five by five Latin squares. There were no significant differences between treatments in mean number of bunches per vine removed, the overall mean being 65.7. In winter, 1950, the vines were pruned in the ordinary course of the pruning of the Research Station vineyard by the farm staff, who were unaware of which treatments the separate vines had received. The vines were examined in spring to determine the percentage of fruitful shoots present, and at harvest the fruit from each vine was weighed separately and a sample taken for sugar determination. The results are shown in Table I. If the treatments were regarded as taking place at equal intervals, the decrease in green weight, and the increase in sugar content, from

TABLE I.

Per cent. fruitful shoots, green weight of fruit per vine, and sugar content of the fruit, after five disbunching treatments.

	Treatments					Significant Difference 5%
	A	B	C	D	E	
Fruitful shoots (%)	45.2	39.2	36.4	36.8	36.5	5.2
Green weight of fruit per vine (lb)	27.0	24.7	21.8	19.2	16.0	4.2
Sugar content (°Brix)	24.29	24.20	24.55	24.77	25.11	0.31

A to E were significant linear regressions.

The results were not entirely satisfactory as there was considerable variation among the separate Latin squares for treatments. Nevertheless it is interesting to interpret them in terms of what is known of fruit bud formation.

All anlagen likely to differentiate as inflorescence primordia in buds which could be retained at pruning are formed by about the middle of December (Barnard and Thomas, 1933), but the latest time at which they can differentiate has not been determined. Treatments C, D, and E all had the same per cent. fruitful shoots in 1950-51, while treatment A and, to a lesser and not significant extent, treatment B, were higher. This suggests that unless the anlagen differentiate as inflorescence primordia fairly soon after they are formed they are unable to do so. Although later disbunching does not lead to a higher per cent. fruitful buds being formed it could affect the size to which the primordia grow. Presumably this factor was responsible for the differences in yield between treatments C, D, and E. Sugar content showed the usual negative correlation with green weight, but the differences were not sufficient to affect the yield differences appreciably.

The yield in 1950-51, even from treatment A, did not approach what could have been obtained from the vines in 1949-50. The experiment of Thomas and Barnard, in which also a year of low fruitfulness followed a year of high fruitfulness, gave a similar result: the control vines yielded 41.6 lb of fresh fruit in the year of disbunching, while the disbunched vines yielded only 24.5 lb in the following year. Clearly the current season's crop is by no means the only factor affecting fruit bud formation and yield for the following season.

References

Antcliff, A. J. and Webster, W. J. (1955)—Studies on the sultana vine: I. *Aust J. Agric. Res.*, **6**:

Barnard, C. and Thomas, J. E. (1933)—Fruit bud studies.—II. The Sultana. *J. Coun. Sci. Industr. Res. Aust.*, **6**: 285-94

Thomas, J. E. and Barnard, C. (1937)—Fruit bud studies.—III. The Sultana. *J. Coun. Sci. Industr. Res. Aust.*, **10**: 143-57.

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FEDERAL PRESIDENT, 1955
DR. H. C. FORSTER

Dr. H. C. Forster, Assistant Executive Officer of C.S.I.R.O., has been elected Federal President of the Institute for 1955. The announcement was made at the twenty-second General meeting held in Adelaide last March.

Dr. Forster has been closely associated with the work of the Institute for many years, more particularly in Victoria, where he has been an active member of the State Branch, of which he was President in 1949. In the Commonwealth sphere he represented the Institute on the Joint Standing Committee of Professional Scientific bodies, which did much to lessen the difficulties that existed in the interchange of scientific personnel between Commonwealth and State Government services. Since 1949 he has been a member of the Publications Committee of the Institute Journal.

Dr. Forster joined the Victorian Department of Agriculture in 1926 where he worked on the development of accuracy in Agricultural experiments and, in particular, on a comprehensive system for testing and assessing varieties of wheat throughout the Victorian wheat belt.

In 1935 Dr. Forster became the first Australian Agricultural scientist to be awarded a Fellowship of the Commonwealth Fund of New York. The award enabled him to spend two years doing research at the Iowa State College and the University of Ames in the U.S.A. He received his degree of Doctor of Philosophy at this University in 1937, having carried out research into plant genetics and mathematical statistics.

Returning to Australia, Dr. Forster was appointed to the position of Senior Cereal Research Officer in the Victorian Department of Agriculture.

From 1942-46 he was Chairman of the State Executive of War Agricultural Committees; and in 1946 became Assistant Secretary to C.S.I.R.O. He was appointed to his present position in 1949.

Dr. H. C. Forster.

Dr. Forster has had wide experience of Australian agriculture and is well aware of the problems that have to be faced by all who seek progress in its many fields. In particular, he is highly appreciative of the part the Institute can play, and we can feel certain that, under his guidance, 1955 should be a year of considerable achievement.

AUSTRALIAN MEDAL OF AGRICULTURAL SCIENCE
AWARD FOR 1955 TO DR. C. R. MILLIKAN

The Australian Medal of Agricultural Science has been awarded this year to Dr. C. R. Millikan, Deputy Biologist and Senior Plant Pathologist in the Victorian Department of Agriculture.

The award is based on the oustanding contributions Dr. Millikan has made to fundamental knowledge relating to nutritional disorders of plants, and also for his work on the diseases

of flax. His monograph on this latter subject is recognised as the Australian Authority, and is acknowledged overseas as a valuable reference.

Dr. Millikan graduated from the Melbourne University in 1931 and then joined the Victorian Department of Agriculture, where he spent some time working with the Horticultural Division. He subsequently transferred to the Biology Branch of the Department where he has remained for the past 20 years.

Dr. C. R. Millikan.

His earliest work in this Branch concerned the relationship between nutrition of wheat and its susceptibility to flag smut. He discovered the resistance of the variety Gurkha to flag smut, and the subsequent work of the Department in exploiting this resistance has reduced the disease to one of minor importance. In 1936, Dr. Millikan demonstrated for the first time the effect of zinc on the eel worm sick soils of the Wimmera. He later showed the susceptibility of wheat to eel worm on these soils was due to a deficiency of zinc in the soil.

During the war Dr. Millikan worked on the elucidation of flax diseases. As a result of his investigations three diseases new to science were discovered, all of which were, in some measure, causing reduced crop yields. One of these, known as "Withertop," was found to be due to a mild deficiency in soil calcium, while another known at "lower leaf scorch" was found to occur when an excess of manganese and a deficiency of molybdenum occurred together in the soil. In his work on this latter disease Dr. Millikan made use of the radio isotopes of manganese, which had been developed by the Atomic Energy Commission in U.S.A. This was the first instance of their use in plant disease research.

In 1953 Dr. Millikan was awarded a Fulbright Smith-Mundt Fellowship which enabled him to spend eight months at the California Institute of Technology. During this period he carried out research into the effect of climate on the nutrition of subterranean clover. Returning via the United Kingdom, he represented Australia at the Fifth Commonwealth Mycological Conference in London.

Dr. Millikan's extensive knowledge of deficiency symptoms in a wide range of plants, particularly clovers, has been of inestimable value to colleagues working on various aspects of trace element deficiencies. His painstaking accuracy and skill in the meticulous techniques required in his work are greatly admired by his fellow workers.

Previous recipients of the Australian Medal of Agricultural Science have been:—

1954, A. F. Bell, B.Sc.M.S., D.I.C., for his executive work in both the Commonwealth and his own State (Queensland).

1953, D. S. Riceman, B.Agr.Sc., M.Sc., whose work in South Australia has permitted the development of the Ninety Mile Desert (now Coonalbyn Downs) where economic agriculture was formerly impossible.

1952, Prof. E. J. Underwood, B.Sc.(Agric.), Ph.D., for his contribution to agricultural science through teaching, research and the direction of research.

1951, E. A. Cornish, B.Agr.Sc., M.Sc., D.Sc., for his exhaustive study of the trends in yield for the South Australian wheat belt.

1950, Prof. J. A. Prescott, C.B.E., M.Sc., D.Sc., F.R.S., for his work on the classification and mapping of Australian soils.

1949, Prof. W. L. Waterhouse, M.C., C.M.G., D.Sc.Agr., D.I.C., for his work on the rusts of wheat.

1948, Prof. S. M. Wadham, M.A., Ag.Dip., in particular for his work on the Rural Reconstruction Commission.

NEWS ITEMS

International Wool Secretariat.

The Annual Meeting of the International Wool Publicity and Research Fund Executive commenced in London on May 31st. The Executive is the supreme wool promotion and research authority of the International Wool Secretariat.

The Secretariat, which promotes the use of wool in seventeen countries, is financed jointly by Australia, New Zealand and South Africa, and has an annual budget of about £1,000,000 sterling. Australia, as the world's major wool producer and exporter, contributes approximately 62 per cent. of this amount.

Australian delegates to the meeting of the executive were Mr. C. B. Ball, Chairman of the Australian Wool Bureau, and Mr. T. G. Carter, a member of the Bureau.

During the course of their visit overseas, Mr. Ball and Mr. Carter are to visit wool textile and research centres in the United Kingdom. Mr. Ball will study wool promotion methods in the U.S.A. before returning to Australia, while Mr. Carter will survey the promotion activities of the International Wool Secretariat on the Continent and attend the annual conference of the International Wool Textile organisation in Munich this month.

Wheat Information Service.

At the 9th International Genetics Congress held at Bellagio, Italy, in 1953, wheat geneticists representing nineteen countries decided to publish Wheat Information Service as a medium for information and exchange of methods, materials and stocks, results and ideas for the promotion of international co-operation in wheat genetics.

W.I.S. No. 1 has now been published and it contains a list of genetic stocks held at the Laboratory of Genetics, Kyoto University, Japan; suggested rules for nomenclature and symbolisation of genes; and information about an educational film, "Origin of Wheat," which is available.

Efforts are being made to increase the membership of the W.I.S. and the publication is distributed free of cost. All interested members should contact —

Dr. K. Yamashita, Managing Editor,
Editorial and Business Office of W.I.S.,
Laboratory of Genetics, Biological Institute,
Kyoto University, Kyoto, Japan.

Unesco and Agriculture.

The United Nations Economic, Social and Cultural Organisation, which is doing valuable work to assist under-privileged communities, bases its aims and ideals on the Universal declaration of human rights.

The following statement, contained in an official U.N.E.S.C.O. document, throws light on the part this body is playing in the development of agriculture in various countries:—

"So also in the sphere of *Science*. Many of the great human problems have not yet been solved. Nearly one-third of the habitable area of the earth does not have enough water. More food can be created, but one central principle, the mechanism by which the green plant uses sunshine and stores it in the form of food, is unknown. A lag exists between the growth of food supplies and population increase. If everyone has the right to an adequate standard of living, as the Human Rights idea insists, these problems cry out for an answer. Unesco, promotes their solution by Arid Zone studies, by the stimulation of research in pure and applied science, by technical assistance to aid scientific progress. Such Unesco projects are now planned not only to assist science but, through it, to promote human rights."

The most recent Arid Zone Conference was held in New Mexico during May. Mr. R. W. Prunster and Mr. R. W. Jessup of the C.S.I.R.O. Division of Plant Industry attended, together with Mr. C. S. Christian, Officer in Charge, Land Research and Regional Survey Unit, who is C.S.I.R.O. Arid Zone Liaison Officer.

New Experiment Station at Samford.

The Plant and Soils Laboratory of the C.S.I.R.O., Brisbane, has acquired a 205-acre property at Samford for experimental purposes. The property is in the process of development and replaces the 8-acre block at Strathpine. Grazing trials and experiments in plant nutrition, genetics and agrostology will be established on the Samford property.

A.N.Z.A.A.S. Meeting, Melbourne, 1955.

The thirty-first meeting of the Australian and New Zealand Association for the Advancement of Science will be held in Melbourne from August 18th to 24th, 1955.

A preliminary note concerning the meeting appeared in the March issue of this Journal, and included details of membership for those who will be attending the meeting.

Symposium with A.I.A.S.

A Symposium arranged jointly between Section K of A.N.Z.A.A.S (i.e., Agriculture and Forestry) and the Australian Institute of Agricultural Science will be held on the afternoon of Friday, August 19th, commencing at 2.15 p.m.

The theme of the Symposium will be "Efficiency in Agriculture" and papers will be contributed by the following:—

Dr. K. O. Campbell, Reader in Agricultural Economics at the University of Sydney, whose subject will be "The Determinant of Agricultural Efficiency"; and Dr. A. R. Callaghan, Director of Agriculture, South Australia, who will speak on "Relationships between Diversification and Efficiency in Agriculture."

Arrangements are being made for a third paper to be given by a New Zealand representative.

Following the Symposium an evening social function will be held, at which the Victorian Branch of the Institute, in conjunction with the Melbourne University Agricultural Society, will be hosts to Section K visitors.

A.N.Z.A.A.S. Programme—Section K (Agriculture and Forestry).

Following is a list of Symposia to be held by Section K of A.N.Z.A.A.S. Where two titles appear for discussion at the one time, the first relates to the Agricultural sub-section, and the second to the Forestry sub-section, which will meet separately on these occasions.

Thurs., 18th August.

9.30 a.m.—Presidential Address.
2.15 p.m.—"The Availability of Power from tractors."
"Silviculture of Softwood plantations in Australia."

Fri., 19th August.

9.30 a.m.—"Utilisation of Pasturage."
"Problems in Natural Regeneration of Eucalypt Forests."
2.15 p.m.—"Efficiency in Agriculture."
"Silviculture of Victorian Messmate-Peppermint Foothill Forests."

Sat., 20th August.

Excursions.

Mon., 22nd August.

9.30 a.m.—"Utilisation of Marginal Land for Farm or Forest."

2.15 p.m.—"Vegetative Cover in Relation to Water Resources of a Catchment."

Tues., 23rd August.

9.30 a.m.—"Transpiration and the use of Water by Plants."

2.15 p.m.—"Sulphur."

Miscellaneous papers will be presented to the Forestry Sub-section.

Wed., 24th August.

9.30 a.m.—Discussion—The Application of Climatic Indices.

2.15 p.m.—Excursions.

Thurs., 25th August.

Post-Conference excursions.

Excursions Arranged for Section K.

Three excursions have been arranged between August 20th - 27th, 1955.

Sat., 20th August.

Full-day excursion—100 miles tour, including Scoresby Horticultural Research Station, Potato Research Farm, Toolangi, and I.C.I. Merrindale Research Station, Croydon, and Woodstock Soil Conservation demonstration.

Cost £1 per head.

Leader: Mr. Frank Read, Superintendent of Horticulture, Department of Agriculture.

Wed., 24th August, 2 p.m.

Half-day excursion to the Melbourne and Metropolitan Board of Works Sewerage Farm at Werribee.

Leader: Mr. H. E. Harding, Senior Divisional Engineer, S.R. & W.S.C.

Cost 10/- per head.

Thurs. to Sat., 25th-27th August.

Three-day excursion, including:—

Pasture Trace Element Experiments at Elmhurst, Wimmera Wheat growing areas and Longerenong Agricultural College, a Western District Sheep Station, the State Research Farm, Werribee.

Leader: Mr. W. B. Miller, Senior Inspector of Agriculture, Department of Agriculture.

Cost: £9, including meals and accommodation. A deposit of £2 must be sent with your application. The party is limited to 30.

APPLICATIONS for all excursions must be in the hands of Mr. K. Turner, Soil Conservation Authority, 378 Cotham Road, Kew, Melbourne, not later than *Saturday, July* 2, 1955.

Mineralogy and Soils Mechanics Sections, C.S.I.R.O., Division of Soils.

Recently two new sections of the C.S.I.R.O. Division of Soils have been formed at the Waite Institute. A section of Mineralogy under Dr. K. Norrish will work on clay minerals and a section of Soil Mechanics, under Mr. G. D. Aitchison will deal with foundation soils for buildings and roads.

N.S.W. Flower Growers' Association.

A group of leading commercial flower growers in the Sydney area recently formed the N.S.W. Flower Growers' Asociation. The flower growing industry is becoming an important one in this State and under the energetic secretaryship of Mr. J. M. Temple, the Association is working actively to put the industry on a sound and scientific footing. The possibilities of cool storage of cut flowers, mainly to relieve market gluts, and new packaging methods are receiving attention and some investigational work has been commenced with the co-operation of the Food Preservation Division of the C.S.I.R.O. The appointment of a special officer in the N.S.W. Department of Agriculture to investigate flower disease problems is also a big step forward.

Soil Study Grant.

The University of New England has received a grant of £1,000 from the Rural Credits Development Fund of the Commonwealth Bank to help soil improvement research by the newly appointed Professor of Botany, Dr. N. C. W. Beadle.

Professor Beadle has been working for some years on the problem of replacement of soil nitrogen and organic matter in the semi-arid section of New South Wales. The problem is very largely one of re-establishing native salt bushes and pasture grasses in the area. In making the announcement the Vice Chancellor of the University, Dr. R. B. Madgwick, spoke of the great importance of research grants of this sort and made a plea for further help from benefactors to enable other agricultural research problems to be investigated both at the New England and other Universities.

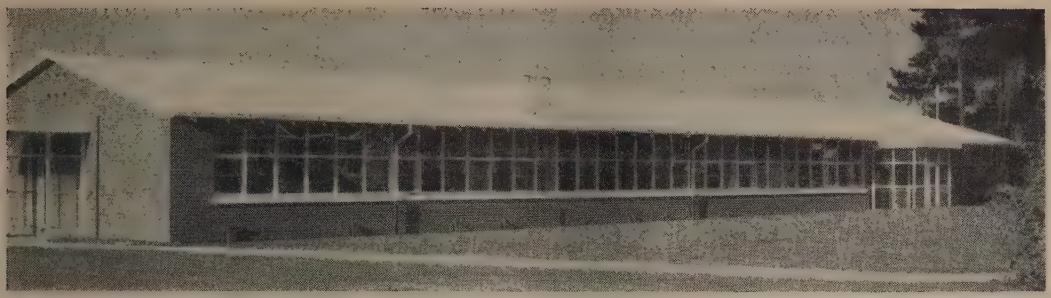
Co-operative Pastoral Research at Armidale, N.S.W.

C.S.I.R.O. and the University of New England have agreed that pastoral research by C.S.I.R.O.'s Regional Laboratory at Armidale, and by the University's newly established Faculty of Rural Science, shall be closely linked, so that the resources of both can be related and used to best advantage. To bring this about a small Research Committee is being established.

For the time being, the Committee will comprise—Professor G. L. McClymont, recently appointed to the Chair of Rural Science at the University of New England, who will act as Chairman and University representative; Mr. R. Roe. the senior officer at Armidale of C.S.I.R.O.'s Division of Plant Industry, who will be Deputy Chairman and representative of the Division of Plant Industry; Dr. A. T. Dick, of the Division of Animal Health and Production, Parkville, who has been appointed because of his outstanding knowledge and experience in the problems of animal and plant relationships, which will be of particular importance in the research programme at Armidale; and Mr. J. F. Barrett, of the Armidale Regional Pastoral Laboratory, who will act as Secretary and Executive Officer of the Committee. The Chiefs of C.S.I.R.O.'s Divisions of Plant Industry and Animal Health and Production will be members of the Committee *ex officio*.

In this way the resources of C.S.I.R.O.'s field station at "Chiswick," including the additional facilities which are to be provided there, will be available to workers from the University, and similarly the resources and laboratories of the Faculty of Rural Science will be available to C.S.I.R.O. workers, who are engaged on field experiments or laboratory researches under the general direction of the Research Committee.

The purpose of this arrangement, which has been made after most careful consideration by the Executive of C.S.I.R.O. and the University of New England, is to ensure that the research potential of both organisations is utilised fully and without wasteful competition or over-lapping in the investigation of the regional problems.



"Merrindale" Research Station recently established by I.C.I.

"Merrindale" Biological Research Station.

Imperial Chemical Industries of Australia and New Zealand have recently established a biological research station known as "Merrindale," at Croydon, 20 miles east of Melbourne. The station, which is situated on a 140-acre property facing the Dandenong Ranges, was officially opened in November last by Dr. Alexander Fleck, Chairman of I.C.I., London.

The pattern of establishment of the station follows closely along the lines of English I.C.I. laboratories at Hawthorndale and Jealotts Hill. Existing farm buildings have been converted and extended to provide laboratories of modern design, fully equipped for intensive biological research. Some of the apparatus being used is of overseas design and has not previously been used in this country. This includes a precision spraying device known as the Potter Tower for treating small batches of insects, a microdrop syringe for firing measured drops of pesticide on to an insect or plant, a small low volume sprayer for plot work and two types of laboratory plant chambers for plant spraying.

The work of the station will embrace research into plant pests and diseases, weed control, and the control of animal diseases. Intensive investigations are being made to discover and formulate new chemical compounds for efficient control of plant and animal pests and diseases; and testing of agricultural chemicals under field conditions will be an important feature.

Head of the station is Mr. F. J. D. Thomas, B.Sc., London. Mr. Thomas was formerly Deputy Head and Chief Entomologist of the I.C.I. Hawthorndale Laboratories in England. He has studied pest control problems in many countries and has specialised in the development of test techniques for pesticides and the control of certain soil pests. He has under him a staff of graduates working in each field of the research activities being carried out.

The Station will work in close association with C.S.I.R.O., Federal and State Departments of Agriculture, and the Universities and will provide a welcome addition to biological research facilities in Australia.

Ferguson Tractor Output.

Following his recent visit to Australia, the Managing Director of the English Standard Motor Coy. Ltd. (Mr. A. S. Dick) said that £2,250,000 will be spent this year on boosting output of Ferguson tractors from the Company's plant at Coventry, England.

Much of this amount will be spent on streamlining production techniques in order to raise the annual output. In 1954 the company produced 64,400 Ferguson tractors.

Mr. Dick stated that progress in the development of mechanised farming had been particularly rapid in the past 20 years. Although many farmers are faced with shortage of labour he felt that those who are engaged in large scale production of agricultural machinery can claim that they are compensating the farmer by providing him with equipment which enables him to effectively undertake more work with less labour.

1955 Graduation, Sydney University.

On 28th April the first two Ph.D. degrees in Agriculture were conferred at Sydney University. Mr. H. B. Kerr was the first Sydney agricultural graduate to be awarded a Ph.D. from this University. It was granted for his studies on the pathogen *Melampsora lini* in Australia, with particular reference to physiological specialisation and the genetics of host resistance.

Mr. Dilbar Singh Athwal, B.Sc. (Agr.) (East Punjab) was awarded a Ph.D. for his work on the genetics of the resistance of wheat to stem rust (*P. graminis tritici*) and leaf rust (*P. triticina*) with particular reference to the genes involved.

Mr. R. A. Daly was awarded the degree of M.Sc.Agr., twenty-five B.Sc.Agr. degrees were conferred, three with honours, and Mr. K. S. McWhirter was also awarded the University Medal at graduation.

International Wool Textile Research Conference, Australia, 1955.

To mark the expansion of research into the wool textile field in Australia an international wool textile research conference will be held during August and September this year. Leading wool scientists from the British Commonwealth and the United States will meet Australian scientists to discuss the latest developments in wool research, and delegates from France, Germany, Sweden and Japan are also expected to attend.

The conference, which is sponsored by C.S.I.R.O. and the Australian Wool Bureau, will be the first of its kind to be held in this country. The objects of the conference are:—

1. To discuss the latest developments in wool textile research and in sciences having a bearing on it.

2. To promote interest and activity in wool textile research among scientists working in associated fields.

3. To encourage the industrial application of research results.

The Conference is expected to stimulate world wide interest in wool research and utilisation and will provide a unique opportunity for bringing the latest developments of scientific research to bear on the problems of the wool industry.

Conference Arrangements.

The conference will commence in Sydney on Monday, August 22nd, 1955. On Friday, August 26th, delegates will leave by road for Geelong, where the conference will be continued from August 31st until September 2nd. The final sessions will be in Melbourne from September 5th until September 9th.

In each centre visits will be arranged to Universities, C.S.I.R.O. laboratories and places of technical interest.

To enable visitors to see as much as possible of the wool growing industry the trip from Sydney to Geelong will include visits to leading Merino stud properties, research field stations and other places of interest.

Information leaflets will be issued from time to time as planning of the conference proceeds. Further particulars may be obtained from:—

The Conference Secretary, International Wool Textile Research Conference, c/o C.S.I.R.O., Wool Textile Research Laboratory, 343 Royal Parade, Parkville, N.2., Victoria.

General Features of the Programme.

Each session comprises 1½ hours. There will be twenty-three scientific sessions devoted to the presentation of new research results in the fields of (a) Chemistry and Biochemistry of Proteins—the Structure of Keratin and the Wool Fibre, (b) Wool Physics and Fibre Assemblies, and (c) Wool Technology.

The Conference will also include seven one-hour lectures and two public lectures. Of particular interest will be a special session to be held in Sydney entitled "The Problems of the Producer and the Biologist in meeting the needs of the Textile Industry."

Plant Diseases Conference.

Approximately 60 delegates will be attending a Plant Diseases Conference which will be held under the aegis of the Australian Agricultural Council at Hawkesbury Agricultural College from the 27th June to 1st July, 1955. The Conference is being convened by the C.S.I.R.O. in collaboration with the New South Wales Department of Agriculture, and will be officially opened by Dr. R. J. Noble.

The first session will provide an opportunity to review the major changes in the plant disease position over recent years. The last assessment of the position was made at a similar conference held in 1949. Other sessions will deal with brown rot, black spot, advances in principles of disease control, virus diseases of plants, pasture diseases, cereal root rots, mineral deficiencies, nematodes, fruit transportation diseases, diseases caused by *Pseudomonas syringae*, and certain quarantine matters of concern to plant pathologists. Review papers are being prepared for all sessions.

The N.S.W. Branch of the A.I.A.S. and the Sydney University Agricultural Graduates' Association are arranging a Buffet Tea for delegates on Thursday, 30th June; a meeting will follow at the Sydney University.

C.A.B. Review Conference.

The Commonwealth Agricultural Bureaux Review Conference being held in London this year commences on June 8th, and after inspections of various bureaux, will end on July 7th.

The Australian delegation will comprise Sir Ian Clunies Ross (Leader), Dr. W. A. T. Summerville, Mr. J. E. Cummins and Mr. E. F. Riek. Mr. W. Ives will be in attendance.

Bird Banding.

The C.S.I.R.O. Wildlife Survey Section in Canberra has organised an Australia-wide bird banding scheme based on centres at Canberra and Perth to study the habits and migrations of Australia's bird life.

This is part of C.S.I.R.O.'s long range programme for the study and assessment of Australia's wild life, and is aimed to conserve those species which are beneficial to the nation's economy, and to restrict the depredations of those which are injurious to agriculture. Several State Departments have been banding ducks for some years, and this work is being continued in Victoria and West Australia.

Migration of birds has aroused man's curiosity since Biblical times, but the true causes of migration and the means by which birds make their global journeys year after year with unerring accuracy are still unknown.

Comprehensive bird-banding schemes which began in Europe 50 years ago are conducted by Governments in a number of countries overseas, including the United Kingdom, U.S.A., Germany, Japan and New Zealand. This work is carried on throughout the world almost entirely by the mass observation of amateur biologists, and serves very appreciably to fill the gaps in our knowledge of the distribution and abundance of bird life.

The solution of many problems concerned with the distribution and migration of birds requires a knowledge of conditions over an entire country or continent, together with the correlation of data obtained from widely scattered sources. Sometimes co-operation with another country or groups of countries is required. For example, many waders inhabiting Port Phillip Bay, Victoria, migrate to Northern Siberia for the nesting season; the Tasmanian mutton bird does the opposite, for it breeds in Victoria, South Australia and Tasmania but makes a round tour of the Pacific Ocean between each nesting season.

Giant petrels banded by biologists on Heard and Macquarie Islands in the Antarctic have subsequently been found in South Africa, South Georgia, Chile, and the Argentine. Giant petrel chicks banded on Heard Island have been found in the Argentine, 9,000 miles from their birthplace, in less than two months from the time they were known to be able to fly.

C.S.I.R.O. has been banding mutton birds in Bass Strait for over six years, and this has led to a fascinating study of the life cycle of the bird, which is a member of the petrel family. Mutton birds have been shown to migrate in a long and regular cycle, spending the majority of their time in the northern Pacific and returning each year, often to the same nesting burrow, on one of the Bass Strait islands.

Numbered bands are made of aluminium and in special studies where the observer wishes to recognise individual birds through binoculars, coloured celluloid bands are used. Bird banding properly done is neither cruel nor in any way harmful. The weight of the bands does not burden the birds and they cause no other danger. Indeed, any interference with the bird's normal activities would defeat the whole object of the scheme.

Each band bears the inscription "Write Wildlife, C.S.I.R.O., Canberra, Australia" and a serial number. Anyone finding a band on a dead bird should return it to the Wildlife Survey Section, Canberra, with details of time and place of the find. If a banded bird is captured alive, the band should not be removed, and details of band, bird and circumstances should be reported to the Wildlife Survey Section, C.S.I.R.O., P.O. Box 109, Canberra City, A.C.T.

Visiting Scientists.

Professor Walter S. Phillips, of the Botany Department, University of Arizona, has been visiting the pastoral areas of Western Australia in company with local agriculturalists.

Three eminent scientists from the University of California are visiting or have visited South Australia this year. *Dr. P. R. Stout*, Professor of Plant Nutrition, Berkeley, is working at the C.S.I.R.O. Division of Biochemistry and General Nutrition for about nine months this year. *Dr. C. M. Johnson*, Department of Plant Nutrition, Berkeley, is working at the Waite Agricultural Research Institute on micronutrient nutrition, also *Dr. H. P. Olmo*, Professor of Viticulture, Davis, is working at the Institute of Agriculture, University of Western Australia, and recently visited South Australian and Victorian grape-growing areas.

Dr. J. C. Smith, Lecturer in Organic Chemistry at the celebrated Dyson Perrins Laboratory, University of Oxford, is making a three months' visit to the C.S.I.R.O. as a "guest worker" at the Division of Industrial Chemistry in Melbourne. Dr. Smith has for many years made his main interest the study of long chain compounds, which are the important components of vegetable and animal fats and waxes. He has made valuable contributions to the scientific knowledge of oils and fats.

Dr. Smith is one of the first group of scientists to be awarded a bursary under the recently inaugurated Royal Society and Nuffield Foundation Commonwealth Bursaries Scheme. The Commonwealth Bursaries Scheme was inaugurated in 1954 jointly by the Royal Society of Great Britain and the Nuffield Foundation to enable scientists who have already demonstrated their research ability to extend their experience overseas in a British Commonwealth country where the scientific environment is peculiarly favourable.

PERSONAL NOTES

Australian Capital Territory.

Recent appointments to the Division of Plant Industry, Canberra, include *Mr. J. B. Langridge* and *Mr. Lloyd Davies*. Mr. Langridge has just completed two years with Professor Catcheside at the Adelaide University and has joined the genetics team to work on developmental genetics. Mr. Langridge is a New Zealander and originally worked with the Crop Research Division of the D.S.I.R. at Lincoln. Mr. Lloyd Davies, a Bangor trained agrostologist, will be working with Mr. Willoughby on pasture utilization.

Mr. W. M. Willoughby has just returned from visiting grassland and animal research stations in New Zealand and will now be extending his pasture utilization studies to cattle-sheep grazing combinations.

Miss Nancy Burbidge has recently returned from a visit to England. She was Australian Visiting Botanist at Kew and while there she authenticated some 3,000 specimens from the Canberra collection, worked on the Robert Brown manuscripts and supervised the photography of almost 3,000 type specimens.

Dr. O. H. Frankel left for U.S.A. in April to attend the Cold Spring Harbour Symposium on Quantitative Biology. He will have a week in London and will visit research institutions in America, returning to Australia in August.

Dr. T. H. Strong recently returned to the Bureau of Agricultural Economics after six months' long service leave. While overseas he accepted a United Nations technical mission in Egypt as Assistant Director of a training

school for technical experts from Middle East countries on economic and financial appraisal of agricultural plans and projects.

Dr. Strong later visited the U.S.A. and completed his doctorate at the Littauer School of Public Administration in the University of Harvard which he had attended during the tenure of his Commonwealth Fund Fellowship in 1948-50.

The Littauer School is the centre of post graduate training in advanced economics and government and public administration.

Mr. C. S. Christian, Officer-in-Charge of Land Research and Regional Survey Section, C.S.I.R.O., left Sydney on 5th April for a six months visit overseas. He will spend three months in U.S.A. reviewing the range improvement, management and re-seeding work especially in the arid and semi-arid regions and will attend the International Arid Lands Meetings at Albuquerque and Socorro, New Mexico, April 26 - May 4, 1955. He will also examine rice investigations, cattle pasture work and dryland farming research in the southern States.

Mr. Christian will pay a short visit to England and Europe where he will visit U.N.E.S.C.O. headquarters in Paris and F.A.O. headquarters in Rome. He will spend ten days in Israel examining arid and semi-arid zone work and will visit the Commonwealth Livestock Farm, Thal, Karachi.

Mr. R. O. Slatyer, of L.R.R.S. Section, C.S.I.R.O., left Canberra in April for twelve months, on a visit to Israel, Africa, England and U.S.A. Most of his time will be spent in the U.S.A. where he has been offered a Senior Research Fellowship by Duke University, North Carolina. He will be studying plant responses to conditions of extreme soil moisture stress as part of his own climatological investigatiions.

Two recent appointments have been made to the climatology unit of L.R.R.S., C.S.I.R.O. They are *Mr. J. L. Frith*, a graduate of the University of Western Australia and *Mr. J. C. Turner*, a graduate of the University of Sydney.

New South Wales.

Dr. I. A. Watson, Dr. N. H. White and *Mr. J. M. Vincent*, formerly Senior Lecturers in their respective fields in the School of Agriculture at the University of Sydney have been appointed to Associate Professorships in Genetics and Plant Breeding, Plant Pathology and Agricultural Microbiology, respectively. The Senate of the University is to be congratulated in recognising both the work being done by the recipients in teaching and research and the growing importance of the Faculty of Agriculture.

Associate Professor I. A. Watson is now in America on sabbatical leave and is working at the University of Minnesota leading a research group investigating rust resistance in wheat.

He has also been honoured by being appointed Commonwealth representative at the International Rust Conference to be held in Mexico.

Mr. E. A. Southee, formerly principal of Hawkesbury Agricultural College for many years, has been awarded the 1955 Farrer Memorial Medal. In making the announcement Dr. R. J. Noble, Chairman of the Farrer Memorial Trust pointed out that the award was made annually to commemorate the work of William Farrer and to honour a person who had rendered distinguished service to agricultural science. Mr. Southee was one of the very early graduates in agriculture from the University of Sydney, is a Vice-President of the Royal Agricultural Society and is an active member of the Royal Society.

Mr. W. V. Single, a research agronomist in the N.S.W. Department of Agriculture has been awarded the Farrer Memorial Research Scholarship. He will continue his studies of cold resistance in wheat at one of the leading research institutions in Britain. Mr. Single's work has already made a significant contribution to an understanding of the often under-estimated problem of frost damage in wheat.

Mr. Rey Manquey, who graduated in Agriculture in 1954 after holding a U.N.E.S.C.O Scholarship at Sydney University for four years is continuing, as a Colombo Plan Fellow his post-graduate research on the rhizobial requirements of tropical legumes, and legume establishment, in the Pilliga area of N.S.W.

Recent appointments to the scientific staff of the N.S.W. Department of Agriculture include: *Miss Vinley Johnson*, to the Biological Branch where she is commencing work on the diseases of flowers; *Mr. R. Richards*, also to the Biological Branch to work on soil bacteriology; *Mr. C. Walkden-Brown* has replaced Mr. G. Nicholson as cereal specialist.

It is understood that *Mr. L. H. Bird*, Senior Chemist at the Wheat Research Institute, Christchurch, New Zealand, has accepted appointment to the Wheat Research Institute at Wagga, N.S.W., to take charge of the cereal chemistry investigations. The Wagga Institute is fortunate in obtaining the services of a cereal chemist of Mr. Bird's calibre.

Queensland.

Dr. W. A. T. Summerville, the Director of Plant Industry in the Queensland Department of Agriculture and Stock, is to proceed overseas to undertake enquiries on behalf of the Department. Dr. Summerville's mission includes a study of the organisation of agricultural extension methods in both the United States of America and the United Kingdom. He will relate this in particular to pasture work and will be concerned with the latest advances in both beef and dairy pasture research.

The trip is being timed to enable Dr. Summerville to attend two agricultural science conferences. He will be one of the representatives of the British Commonwealth at the Commonwealth Agricultural Bureau's conference in London from mid-June to July. During late August he will attend an International Horticultural Congress at The Hague. He will be

absent from Australia for approximately five months.

Mr. C. G. Hughes, Senior Pathologist with the Bureau of Sugar Experiment Stations, is to proceed overseas during May. At the present time, the major pathological problem of the Australian sugar industry is the ratoon stunting disease of sugar cane. Investigations have reached the stage where the results of research in other crop plants may be of value to Bureau investigations.

Owing to the virus nature of the ratoon stunting disease, Mr. Hughes will be concerned principally with modern research into plant virus diseases. He will confer with plant pathologists in England, Holland, Sweden and the United States of America. An extensive tour of universities within the United States is planned, including the Universities of Cornell, Wisconsin, Washington, California and Hawaii. He will return to Australia via Hawaii at the end of September.

Mr. W. W. Bryan, Senior Agronomist, C.S.I.R.O., was a member of the South Pacific Commission grassland survey team. He was absent from Brisbane from early January to mid-March. Mr. Bryan spent two weeks in Dutch New Guinea, three weeks in the Territory of Papua and New Guinea, ten days in Fiji (Viti Levu) and two weeks in New Caledonia. Members of the team decided a research programme for increased beef production and advised accordingly.

Mr. Ross Humphreys, recently of the New South Wales Soil Conservation Service, was appointed Research Officer in the Department of Agriculture, University of Queensland. The appointment is for three years. It was financed by pastoral interests for research investigations into crops and improved pastures in sub-marginal growing areas.

Mr. B. R. Champ, the retiring Honorary Secretary-Treasurer, was transferred during early February from Bisbane to Nambour. Mr. Champ takes over entomological duties from *Mr. T. Manefield* who has been transferred from Nambour to South Johnstone.

Student members for 1954 who recently graduated from the University of Queensland in the faculty of Agricultural Science include: *N. D. Young* who has undertaken agrostological duties at Brian Pastures, Gayndah, for the Department of Agriculture and Stock; *J. R. Pollock,* who has joined the plant pathological section of the Bureau of Sugar Experiment Stations; *R. Logan,* who is farming at College View in the Lockyer Valley; *V. R. Catchpoole,* who is a full-time honours student in agronomy within the University of Queensland; and *M. C. Basu,* who has applied for a transfer to the Victorian Branch of the Institute.

Mr. O. T. Denmead and *Mr. L. Eadie,* who were honours students in Agricultural Science, University of Queensland, have obtained appointments in the C.S.I.R.O.

South Australia.

Mr. B. C. Jefferies has commenced eight months' work in a post-graduate school for sheep and wool extension officers in New South Wales, Queensland and Victoria.

Mr. J. C. M. Fornachon returned in February after an extensive trip through grape-growing regions of Germany, France and South Africa.

Dr. F. L. Milthorpe has left the Waite Institute to take up a Chair at the University of Nottingham, England.

Tasmania.

Mr. L. Miller, Immediate Past-President of the Branch, left during April on a visit to the United Kingdom and the United States. He will visit entomological research centres in each country.

Victoria.

Mr. J. P. Ryland has been appointed General Manager of Trans Australia Airlines.

Mr. R. R. Hedding is back with the Agrostology Branch of the Department of Agriculture after two years in England.

Mr. R. van Baer is working on insecticides at Rothamstead.

Miss Jill Naylor has left C.S.I.R.O. to spend three years overseas.

Miss Yvonne Aitken has gone to England for a year.

Miss Margaret Dettman and *Dr. I. Molnar,* both of the Soil Conservation Board, have also gone abroad.

Mr. L. L. Stubbs has been awarded a Commonwealth Fund Scholarship.

Mr. W. A. Beattie has left Australian Estates to go to Uruguay with F.A.O.

Mr. John Landy has been awarded the M.B.E.

Mr. John Papadopoulos, of Cyprus, is doing post-graduate study on reproduction in sheep with Dr. T. J. Robinson at Melbourne University.

Mr. J. W. Meagher, of the Victorian Department, has leave of absence to study at Rothamstead.

Western Australia.

Dr. D. P. Drover, Lecturer in Soil Science at the Institute of Agriculture, has been awarded the Ph.D. degree for work on soil nitrogen changes in wheat belt soils.

Mr. L. Gaffney, Poultry Branch, Department of Agriculture, will leave in July to take up a graduate assistantship at the Purdue University, Indiana, made available by the International Education Programme. The appointment is for twelve months.

Mr. D. A. Johnston, Vegetable Branch, Department of Agriculture, departed for England in February.

Mr. K. Cole resigned from the Department of Agriculture to take up an appointment with the Department of Agriculture in New Guinea.

Mr. K. Newton has taken up an appointment with the Department of Agriculture in New Guinea.

Messrs. L. White and *F. Kuneman* have resigned from the Department of Agriculture to go farming.

Mr. T. Haney, formerly O.I.C. Tobacco Branch, Department of Agriculture, is now in Southern Rhodesia where he has taken up an appointment with the Tobacco Research Trust.

Mr. R. Pearse will leave in July for England to gain further experience in Agricultural Economics.

Mr. L. Shier, Superintendent of Wheat Farming, Department of Agriculture, has been invited to join the Technical Assistance Mission of F.A.O. in Syria for twelve months. His assignment will be to advise the Syrian Government on sheep breeding and sheep husbandry.

Mr. R. G. Woodward has resigned from the Department of Agriculture.

ANNUAL GENERAL MEETING

The Twenty-second General Meeting of the Institute was held at the Waite Agricultural Research Institute, Adelaide, on March 15, 1955.

The President (Dr. I. F. Phipps) was in the chair and Principal Delegates from all Branches except Western Australia were present, together with the Executive Officer and 21 other members of the Institute.

During proceedings two reports of Council were adopted. One concerned the award of the Medal of the Australian Institute of Agricultural Science to Dr. C. R. Millikan, and the other the election of Dr. H. C. Forster as Federal President for 1955. Both reports were received with acclamation.

Presidential Address.

It was agreed that the address by the retiring President, Dr. I. F. Phipps, be given on the occasion of the A.N.Z.A.A.S. meeting in Melbourne during August, 1955. The presentation of the Institute Medal to Dr. Millikan will also be made at this time.

Summary of Resolutions.

The following is a summary of resolutions carried at the meeting:—

Resolved. That the Minutes of the 21st General Meeting, as circulated, be taken as read and signed as a true record.

Resolved. That the Report of Council for the Year 1954, as circulated and read by the Hon. General Secretary, be adopted.

Resolved. That the Report of the Editor for Vol. 20, 1954, as circulated, and read by the Executive Officer, be adopted.

Resolved. That this Meeting expresses the hope that Branch Committees will do more to stimulate articles, particularly review articles, for publication in the Journal.

Resolved. That the Report of the Business Manager for Vol. 20, 1954, as circulated, and read by the Executive Officer, be adopted.

Resolved. That the Audited Statement for Vol. 20 and Budget for Vol. 21, as circulated, and read by the Executive Officer, be adopted.

Resolved. That the matter of honorarium and appreciation to Mr. A. D. North be referred to the Council.

Resolved. That the Audited Statement of Accounts and Balance Sheet for the Year, 1954, as circulated, and presented by the Hon. General Treasurer, be adopted.

Resolved. That the Audited Statement for A.J.A.R. Distribution Account, as presented by the Executive Officer, be adopted.

Resolved. That the future of the A.J.A.R. Distribution Account be referred to Council.

Resolved. That the Audited Statement for the Journal, 1953, deferred from the 21st General Meeting and subsequently circulated to Branches and approved by Council, be adopted.

Resolved. That the Articles of Association be amended as follows:—

(1) That Article 40 be deleted.

(2) That the following new Article be inserted to replace Article 40, namely: "40. The Council of the Institute shall consist of the President, the immediate Past President, the Honorary Treasurer, the Honorary Secretary and one delegate from each Branch."

(3) That Article 44 be amended by the insertion of the words—"the immediate Past-President" after the words "the President and immediately before the words "the Honorary Treasurer."

The votes recorded were as follows:—For, 116; Against, 1; No Vote, 1.

Resolved. That the appreciation of this meeting for the services of the Publications Committee, Qualifications Committee and Recommending Committee for the Australian Medal of Agriculture be recorded and that the members of these Committees be informed by Council.

Resolved. That this Meeting records its deep appreciation for the fine services rendered to the Institute by Dr. I. F. Phipps during his term of office as President.

REPORT OF COUNCIL FOR 1954

It is with much pleasure that the Council of the Institute presents to you its Report for the year ended 31st December, 1954.

Office Bearers.

Office Bearers for 1954 were:—
President: Dr. I. F. Phipps.
Hon. General Secretary. Mr. H. P. C. Trumble.
Hon. General Treasurer: Mr. P. C. Angove.

Branch and Delegate	Proxy
A.C.T., Mr. R. M. Moore	Prof. C. M. Donald
N.S.W., Prof P. R. McMahon	Dr. R. N. McCulloch
Queensland, Mr. W. J. S. Sloan	Mr. K. J. Hutchinson
South Australia, Dr. R. J. Swaby	—
Tasmania, Mr. L. W. Miller	Mr. H. K. Kemp
Victoria, Mr. B. F. McKeon	Mr. G. M. E. Mayo
Western Australia, Mr. M. Cullity	Mr. N. R. McKeown

Council met five times during the year. At the first of these meetings, held just before the 21st General Meeting, the previous year's office bearers conducted the business.

Three delegate-in-person meetings were held (one in Canberra, two in Melbourne). The two meetings of proxies were held in Adelaide. At all meetings the President took the Chair.

Twenty-First General Meeting.

The Twenty-first General Meeting was held in Canberra on 11th and 12th January, 1954. The minutes of this meeting have already been presented.

Executive Officer and Central Office.

At the 21st General Meeting, amendments to the Articles of Association were accepted, giving Council the power to employ paid staff. The General Meeting also instructed Council to consider the establishment of a Central Secretariat and, if satisfied, to proceed with its formation.

The amendments to the Articles were subjected to two separate challenges; one by the President of the South Australian Branch, and the other by a member of the same Branch, holding the necessary proxy votes at the General Meeting.

The attitude of the South Australian Branch was based upon the belief that many of the members who, at the General Meeting, had voted in favour of the amendment to the Articles, were not, in fact, in favour of establishing a Central Secretariat under the amended Articles. No other Branch agreed with this view.

After considerable correspondence and discussion, the demands for a postal vote to confirm the amendments to the Articles were withdrawn and a referendum was conducted to register the Institute's opinion on the question of the immediate establishment of the Central Secretariat.

The referendum was held and on 27th May last, the Returning Officer declared it carried, with 390 votes in favour and 164 votes against.

As soon as the referendum results were known, application was made to the Minister for Commerce & Agriculture for assistance from the Commonwealth Extension Services Grant, as had been promised to the Institute's President for 1953 (Dr. A. R. Callaghan). Approval was given for the Institute to spend up to the following sums from the Grant in the years mentioned: 1953-54, £1,000; 1954-55, £3,000; 1955-56, £2,000; 1956-57, £1,000.

In the meantime, a small Committee, appointed by Council, had called for applications for the position of Executive Officer. Mr. J. A. Roberts, a member of the Institute and former Honorary Secretary of the Victorian Branch was appointed to this position on October 1, 1954.

Mr. Roberts has since established a completely furnished Central Office for the Institute, employing a full-time typiste. Much of the Executive Officer's time has been spent in organising the Central Office, but a visit has been made to the South Australian Branch, and two Council meetings attended. Consideration has also been given to the division of duties between the Hon. General Secretary, Hon. General Treasurer and the Executive Officer.

Australian Medal of Agricultural Science.

Considerable difficulty has been found in the past by Branch Committees in assessing the merit of candidates for the Medal each year. To overcome this, new by-laws were adopted this year, providing for a Recommending Committee of three, one member retiring each year.

The first Recommending Committee was appointed in July, 1954, and consisted of Mr. A. F. Bell (Convenor), Professor S. M. Wadham and Professor E. J. Underwood. The 1955 Medal will be awarded on the basis of this Committee's recommendation.

Continuity of Services of the President.

At the 21st General Meeting, considerable dissatisfaction was expressed at the fact that Institute Presidents held office for only one year. It was pointed out that at the end of his term of office, when he had a thorough command and appreciation of Institute business, a President was required to step down. He could no longer help to guide the decisions of Council in other than an unofficial capacity.

It was decided by Council that some continuity was desirable and the majority of Branches favoured a position as an *ex-officio* member of Council for the immediate past President. Since this requires an alteration to the Articles, arrangements have been made to put the necessary amendments to this meeting.

Joint Session with Section K, A.N.Z.A.A.S.

A very successful Joint Session was held at the 30th Meeting of A.N.Z.A.A.S in Canberra in January, 1954. The Joint Session took the form of a Symposium on "World and Australian Food Production Problems" and was particularly well attended. The Symposium was opened by Dr. F. T. Wahlen, Director, Agriculture Division, F.A.O., and several Institute members gave papers.

It is expected that another Joint Session with Section K will take place at the Melbourne meeting of A.N.Z.A.A.S., August, 1955.

MEMBERSHIP.

	N.S.W.	Vic.	Q'ld.	S,A,	W.A.	Tas.	A.C.T.	Total
Corporate								
As at 31/12/53	236	311	121	133	142	43	67	1,053
Admissions	9	17	8	3	14	7	9	
Transfer Gains	9	6	6	3	3	1	4	
Transfer Losses	8	5	4	7	4	1	3	
Resignations	5	2	—	1	—	—	4	
Terminations	1	—	1	—	—	—	—	
Deaths	1	—	—	—	—	—	—	
As at 31/12/54	239	327	130	131	155	50	73	1,105
Emeritus								4
Student								
As at 31/12/53	73	17	18	15	29	—	—	152
As at 31/12/54	92	29	18	15	38	—	—	192

Brochure—"Careers in Agricultural Science."

A total of 10,000 copies, the first edition of this brochure, were distributed to Branches at the end of 1953 and in early 1954. The Western Australian Branch is preparing its own careers brochure, and will publish this with the aid of finances available to it.

The 10,000 brochures already distributed cost £326/19/6, this expenditure being met from money made available from the Commonwealth Extension Services Grant for the purpose. A second edition of 5,000 copies has been printed and will be distributed early in 1955.

National Register of Scientific and Technical Workers.

During the year, the Department of Labour & National Service started compiling a register of Agricultural Scientists in Australia. The Department has the Institute's co-operation in this venture and it is hoped that we can assist in making the Register complete and keeping it up to date.

Institute Seal.

The Institute has had no Seal or official symbol other than the design used on the Medal and the cover of the Journal. Dissatisfaction with this state of affairs arose during the year and steps were taken to obtain a suitable design for a Seal. This has been done and Council has accepted a design to be used as a Seal on appropriate occasions and also for the Medal and letterhead.

Agricultural Engineering.

There was a revival of interest in this subject during the year. Discussions had taken place for some time between a sub-committee of the Victorian Branch of the Institute and a sub-committee of the Institution of Engineers (Australia). These discussions have now been placed on an Australia-wide basis, with the appointment of a sub-committee of Council, resident in Victoria, but with a corresponding member in each other Branch, to confer with the engineers.

Agricultural Textbook.

Work is continuing, under the leadership of Mr. P. J. Skerman, but the Institute has, as yet, made no decision as to whether it would claim a share of any royalties paid on the Book.

Rural Credits Development Fund.

The Commonwealth Bank once again generously assisted the Institute in the publication of the Journal by making a grant of £200 from the Rural Credits Development Fund.

Qualifications Committee.

The Qualifications Committee, consisting of Messrs. W. W. Bryan (Convenor), C. W. Winders and P. J. Skerman, of Queensland, has continued its important work of scrutinising all applications for corporate membership.

Financial Statement.

Two points are worthy of comment.

(a) Subsidy to the Journal has fallen from £1,200 last year to £200, plus the Rural Credits Development Fund grant of £200, this year.

(b) Arrears of subscriptions remain at the same high level, £1,030/5/-, com-

ARREARS OF SUBSCRIPTIONS.

	1949	1950	1951	1952	1953	1954	Total No.	Value Prior to 1954	Value 1954
N.S.W.	—	—	1	9	15	88	113	£51 9 0	£184 16 0
Vic.	—	—	2	8	23	103	136	67 4 0	216 6 0
Q'land.	—	—	—	3	7	43	53	21 0 0	90 6 0
S.A.	2	2	2	6	8	38	58	35 14 0	79 16 0
W.A.	—	—	1	2	8	39	50	22 1 0	81 18 0
Tas.	—	—	—	2	5	21	28	14 14 0	44 2 0
A.C.T.	—	—	—	—	6	16	22	12 12 0	33 12 0
Totals:	2	2	6	30	72	348	460	£224 14 0	£730 16 0

pared with £1,056 at the end of 1953. A concerted effort on the part of most Branches is necessary to bring these outstanding subscriptions to hand, as is shown by the following table, for corporate subscriptions only.

A total of 152 student subscriptions are in arrears, valued at £74/15/-.

On Behalf of the Council,

I. F. PHIPPS,
President.

COUNCIL PROCEEDINGS

The 141st Meeting of Council was held at the Waite Agricultural Institute, Adelaide, at 9.30 a.m. on Wednesday, 16th March, 1955.

Present: Dr. H. C. Forster (President, in the Chair), Dr. I. F. Phipps (Immediate Past President), Prof. P. R. McMahon (N.S.W.), Dr. T. J. Marshall (S.A.), Dr. L. G. Miles (Q'ld.), Messrs. E. J. Martyn (Tas.), B. F. McKeon (Vic.), R. M. Moore (A.C.T.), N. R. McKeown (W.A.), H. P. C. Trumble (Hon. General Secretary), P. C. Angrove (Hon. General Treasurer); J. A. Roberts (Executive Officer) in attendance, and Prof. C. M. Donald and Messrs. K. H. Northcote and K. J. Hutchinson by invitation.

An apology was received from Mr. M. Cullity (W.A.).

The following is a summary of items discussed.

Executive Officer—Policy.

Terms and Conditions of Appointment.

It was suggested that because of the lack of continuity in the membership of the Council, a set of broad principles should be laid down for the protection of the Executive Officer in case of unexpected variations during the course of his appointment.

Council directed the Executive Officer to examine relevant sections of the Public Service Act for guidance in this matter.

Future Activities—Suggestions by Executive Officer.

Membership.

(a) *A Standing Sub-Committee.*—This was considered a valuable suggestion very worthy of serious consideration, particularly by the larger branches.

(b) *Examination for Admission of Non-graduates.*—Further discussion on this subject was deferred pending a report by Tasmania.

(c) *Higher Level Membership.*—It was agreed that a higher level of membership was a desirable objective. A grade of fellowships would be valuable.

(d) *Royal Charter.*—The Executive Officer reported that requirements for a Royal Charter were being investigated.

(e) *Company Membership.*—Further information on this topic was requested by Council, before a decision could be reached.

Registration of Agricultural Scientists.

It was agreed that the Institute approach the Department of Labour and National Service in order to obtain the register of Agricultural Scientists and keep it up to date.

Agricultural Education.

It was suggested that the Institute could provide an informative opinion with regard to alterations in University courses in Agriculture. After discussion it was agreed that, when appropriate, Branches could examine existing courses at the University and Colleges in their State.

Meetings.

Discussion took place concerning the manner in which the State Branches organise meetings, particularly joint meetings with other organisations. Some States regularly invite members of farmers' organisations to meetings in which they would be interested.

With regard to conferences, the Past President emphasised the need to continually look forward and examine trends. Having this in mind it was agreed that the conduct of conferences is a worthwhile object for the Institute.

Publicity.

Council agreed that every effort should be made by the States to keep the Central Office supplied with information on their activities.

Accommodation for Central Office.

The Executive Officer was directed to explore the possibility of the Institute renting or buying the building in which the Central Office was situated, when it is put up for sale in 18 months' time.

Rotation of Council.

It was suggested that, with the establishment of the Central Office in Melbourne, certain difficulties arose in the handling of finance when Council is located in another State. Possibly, consideration should be given to having Council located in Melbourne. A submission is to be prepared for consideration by Council.

Salary of Executive Officer.

A motion was carried to the effect that the Executive Officer's salary be £2,000 per annum, as from 1st March, 1955.

Membership.

Discussion took place on the subject of whether or not there should be a probationary period before a graduate in other than Agricultural Science is admitted to full membership of the Institute. State opinion differed, two Branches (N.S.W. and A.C.T.) being desirous of the probationary clause being removed al-

together, while the others either desired a discretionary period or two years as at present.

The Executive Officer was directed to present the views of N.S.W. to all Branches for consideration.

Institute Seal.

The new design for the Institute Seal, although opposed by Victoria and A.C.T., was acceptable to Council and the Executive Officer was directed to have the new design substituted for the old one on the Medal of Agricultural Science, the cover of the Journal and Official documents.

Recruitment to the Profession.

To assess the value of the brochures which set out details of a career in Agricultural Science, it was decided that Branches should interview first year Agricultural Science students in the respective universities.

It was further agreed that an article be prepared for distribution to schools.

Principal Delegate.

It was agreed that Branches should give some consideration to allowing the Principal Delegate to hold office for more than one year. Such a move would enable greater uniformity in Policy over a long period.

BRANCH NOTES

Australian Capital Territory.

The Annual General Meeting was held on 4th March, 1955. The following office bearers were elected:—

President, Mr. R. M. Moore.
Vice-President, Dr. D. B. Williams.
Hon. Secretary, Miss M. Mills.
Hon. Treasurer, Mr. J. R. Sleeman.
Hon. Sub-Editor, Mr. R. D. Brock.
Committee Members, Mr. T. T. Colquhoun and Mr. F. Grogan.

The Immediate Past President, Mr. C. S. Christian, is automatically a member of the committee.

Mr. J. A. Roberts addressed the meeting, outlining his duties as Executive Officer.

New South Wales.

The Twentieth Annual General Meeting of the Branch was held in Sydney on 25th February, 1955. In its report for 1954 the Committee of Management showed corporate membership as 235 and student membership as 58, being little different from the previous year. Branch funds at 31/12/54 showed a credit balance of £85/11/10 but a large proportion of the membership was unfinancial and presumably, therefore, disinterested. During the year eight general meetings were held with an average attendance of 34, including 8 visitors. The attendance and interest at the three symposia were considerably higher. The publicising of careers in agricultural science was an important project during the year and 2,000 copies of the brochure were widely distributed. The standard of meetings is being greatly improved by practising a policy of considering "live" subjects by means of symposia or one eminent speaker, allowing plenty of time for discussions, and publicising meetings much more widely. It has been felt for some time that the Institute, in this State at least, is in need of re-activation.

The following office bearers were elected for 1955:—

President, Mr. A. N. Johnston.
Vice President and Principal Delegate, Associate Professor J. M. Vincent.
Hon. Secretary, Mr. J. D. McFarlane.
Hon. Treasurer, Mr. C. L. Goldstone.
Hon. Sub-Editor, Mr. E. G. Hall.
Committee Members, Dr. K. O. Campbell, Dr. M. C. Franklin, Misses B. Carne and H. Wrigley, Messrs. A. S. Peterson and K. Green.

Associate Professor J. M. Vincent delivered the Presidential Address entitled *"Microbiology in the Service of Agriculture."* The service rendered to agriculture by microbiology was considered in relation to agricultural production, i.e., soil fertility, manufacture of commodities derived from agricultural products and the prevention of spoilage of perishable produce. The address will be published as a review article in a later issue.

The main business of the meeting on 29th April, 1955, was a symposium on *"The Flood Problem in N.S.W."* The speakers were *Mr. J. Devery,* Lecturer in Physical Geography, University of Sydney; *Mr. R. Young,* Commissioner, Water Conservation and Irrigation Commission; *Mr. L. G. Kaleski,* Chief Soil Conservationist, N.S.W. Soil Conservation Service; *Professor Denis Winston,* Professor of Town and Country Planning, University of Sydney; and *Mr. J. Rutherford,* Economics Research Officer, N.S.W. Department of Agriculture. There was a large and interested attendance, including a large proportion of visitors and the addresses stimulated a most valuable discussion of the problem.

This symposium was the first step towards formation of a policy by the Branch on the flood problem and it is hoped to publish a review of it in a later issue of the Journal. It was felt by all that while smaller floods could be prevented, major floods could not. However, their effects could be greatly mitigated. One big gap in our knowledge is data on the ability of crop and pasture plants to withstand submergence under water.

Queensland.

The Annual General Meeting of the Queensland Branch was held on 2nd March, 1955. The Branch Office Bearers for 1955 are as follows:—

President, Dr. L. G. Miles.

Vice Presidents, Professor L. J. H. Teakle and Mr. W. J. S. Sloan.

Hon. Secretary-Treasurer, Mr. S. A. Waring.

Hon. Branch Editor, Mr. O. W. Sturgess.

Committee Members, Mr. F. Chippendale, Mr. G. D. Hubble, Mr. W. W. Bryan.

The Executive Officer, Mr. J. A. Roberts, attended the meeting. He outlined to members the scope of his duties.

The Retiring President, *Mr. W. J. S. Sloan,* delivered his presidential address on *"Some Aspects of Land Settlement in the Rain Forest Areas of North Queensland."* Special attention was given to rain forest areas of the Eungella Range at Mackay, the Atherton Tableland and the coastal area between Ingham and Cooktown.

Mr. Sloan stated that it must be recognised that agricultural pursuits have been the major factors in populating North Queensland. Closer settlement in tropical rain forests demands careful consideration to ensure that large quantities of valuable timbers or potential timber-bearing resources are not destroyed beyond the point where the future requirements of Queensland and Australia for cabinet woods are jeopardised.

It was noted that approximately 66 per cent. of the total area of 3,833 square miles originally covered with rain forest still remain under crown control as National Parks, State Forests, Timber Reserves and vacant Crown lands. Approximately 15 per cent. of the area remaining under crown control should prove suitable for further settlement.

An appraisal of the present situation, following the settlement of rain forest areas, was obtained by indicating that 95 per cent. of the annual gross value of primary production of the coastal areas from Mackay to Cooktown, comes from agricultural industries, with forestry being responsible for the remainder.

Deterioration of rain forest lands, following settlement, was fully discussed under the two broad headings of *soil fertility* and *weed problems.*

Mr. Sloan emphasised that North Queensland must develop to the optimum level the food-producing potentialities of the limited areas of rain forest lands. The reliable summer rainfall, excellent supplies of water, good road and rail transport facilities are great advantages for settlement of these rain forest lands north of Townsville.

South Australia.

The Annual General Meeting was held on March 11th, 1955, and the following office bearers were elected:—

President, Dr. T. J. Marshall.

Vice President, Dr. R. J. Swaby.

Hon. Secretary, Mr. P. N. Byrne.

Hon. Treasurer, Mr. N. C. Crowley.

Hon. Sub-Editor, Mr. B. G. Coombe.

Committee Members, Mr. G. Blackburn, Prof. C. M. Donald, Mr. J. C. M. Fornachon and Mr. V. K. Lohmeyer.

Dr. R. J. Swaby, in his Presidential Address, spoke on *"Soil Humus."* He considered the various properties of soil humus and the relationship between these properties and the physico-chemical properties of the constituent biochemicals as follows:—

(a) Black colour after extraction from soil is caused by a quinoid group probably derived from oxidised lignin (melanin?).

(b) Humus is auto-oxidizable in alkaline solution, caused by a phenolic group. Constituents of humus possessing phenolic groups are oxidised lignin and polyphenols.

(c) Humus fixes ammonia so that it is no longer exchangeable, due to a quinoid group derived from oxidised lignin.

(d) Humus acts as a hydrophilic colloid which avidly imbibes water. There are numerous polar groups capable of ionic and H ion bonding with water.

(e) Humus has a negatively charged micelle which is never positively charged. It absorbs cations and chelates with heavy metals. There are numerous anionic groups and cationic groups which are masked. Chelation is due to legand groups.

(f) Humus is capable of glueing soil particles into crumbs, caused by polymerized chains with ionic polar groups. The various constituents in which the groups responsible for properties (d), (e) and (f) can be found, are polysaccharides, polyuronides, proteins and polyphenols.

(g) Humus provides a steady reservoir of plant nutrients. Nitrogen is supplied by amino and ring nitrogen groups found in proteins and nucleic acids, phosphorus in various organic phosphates from phytates and phosphatides and sulphur from thiol groups in proteins and possibly sulphates.

(h) Humus is resistant to microbial attack due to the protective effect of lignin or clay upon humus constituents which combine with them firmly. This effect could be derived from lignin, protein or polyuronides.

At the April Meeting of the Branch *Dr. E. A. Cornish,* Chief of the Division of Mathematical Statistics of C.S.I.R.O., spoke on *"The Variability of Monthly Rainfall in South Australia."* He pointed out that a study of this kind could be employed to determine the expectation of rainfall or to compare the variability of rainfall within or between regions for the purposes of comparative climatology. The former was the objective of the studies in South Australia.

Previous assessments of rainfall probability by easily calculated and approximate methods had been very useful, but the danger of such work lay in the likelihood that the limitations to accuracy tended eventually to be forgotten. The present study was designed to use all available information on any aspect of the rainfall distribution and to determine probabilities with the maximum possible accuracy.

The problems involved in the analysis of monthly rainfall arose from the skew distribution of the rainfall, and the difficulties arising from zero values of rainfall. It was necessary

to adopt logarithmic, square root, and cube root transformations according to the variance involved. The problem of zero values was met by treating the data as compounded of two distributions, viz., a discrete distribution of rainy months and a continuous distribution of falls above zero.

Dr. Cornish presented detailed formulae showing the method of derivation of probabilities, and pointed out that in applying the methods standard statistical tables could be used. The data had been checked for independence by examining the frequencies of runs of monthly rainfall satisfying specified conditions, and all tests demonstrated that the assumptions upon which the analyses had been based were satisfactorily fulfilled.

The probability data can be used in various ways. Calculations had been made of the rainfalls needed to give values of $\frac{P}{S.D.\ 0.75}$ greater than 4, 8 or 12 respectively. Probabilities of a growing season of any particular length or efficiency (in terms of $\frac{P}{S.D.}$ ratios) could be determined by calculating the probability of effective values for say, all five months beginning April, May or June or for the nine months beginning April or any other period it was desired to examine. Dr. Cornish showed maps of South Australia with isolines of probability for various lengths of season. In the agricultural areas of South Australia these show a close relationship to annual isohyets, but it was agreed in discussion that the application of these techniques to other States, and particularly to the summer rainfall areas, might show considerable divergence of probability isolines from rainfall distribution. Professor Prescott emphasised the great value of work of this kind in a country where rainfall was such a critical factor to agricultural production.

At a meeting on February 11th, *Professor C. M. Donald,* newly appointed Professor of Agriculture in the University of Adelaide, spoke on *"The Species Problems in Southern Australia."*

The use of crop and pasture species is governed not only by climate and soils but to a considerable degree also by agricultural practice and social structure. While some species may be developed for specific needs, there will be instances in which a species which can be adapted successfully to the physical environment may have little prospect unless an effort is made to define its role in local agricultural systems and even to modify those systems to absorb what could be a valuable new crop or pasture plant.

Southern Australia has depended wholly on introduced species, first from the cool temperate areas of Europe, in recent decades from the Mediterranean region. The view was expressed that the native pasture flora offered little of likely value as sown species; they are adapted to low fertility levels and are incapable of showing high production levels as fertility is raised. Principal prospects lie in further material of Mediterranean origin.

Professor Donald reviewed the main crop and pasture plants, their adaptation to Australian conditions and the future prospects for improvement. In the established cereal crops considerable prospects for improvement still lie open to the plant breeder, while the work being done on safflower is showing the value of an initial breeding programme as a precedent to commercialisation of a new crop.

To date little has been achieved in the improvement of pasture species, despite many sporadic improvement programmes. Apart from the commercialisation of naturally occurring strains of subterranean clover, Australia has done little towards the selection or breeding of adapted strains of pasture plants. There is evidence that the material in use in many species could well be replaced or added to through introduction, selection and plant breeding. Examples were quoted from *Phalaris, Dactylis* and other pasture genera, and among the grain legumes.

Professor Donald stressed the tremendous potential available both for widening the range of species in use in Southern Australia and for the improvement of species already in use.

Tasmania.

The Nineteenth Annual General Meeting was held on 4th March, 1955, when the following office-bearers were elected:—

President, Mr. E. J. Martyn.
Vice-President, Professor H. N. Barber.
Hon. Secretary, Mr. I. D. Geard.
Hon. Treasurer, Mr. J. R. Ward.
Journal Sub-Editor, Mr. D. Berry.
Publicity Officer, Mrs. G. Cartledge.
Committee Members, Mr. K. D. Nicholls and Mr. G. C. Wade.
Hon. Auditor, Mr. D. Martin.

The address by the retiring President, Mr. L. Miller, was entitled "A Decade of Entomology in Tasmania."

Victoria.

The only meeting of the Victorian Branch held this year was the Symposium on *"The Development of Scientific Agriculture in Victoria —Past and Future,"* held on April 20. This meeting was attended by about 200 members and visitors. The main addresses are printed in the "Review Article" section of this issue of the Journal.

Western Australia.

The Annual General Meeting of the Branch was held on 22nd April, at which the following Office Bearers were elected for 1955:—

President, Mr. P. N. Forte.
Vice President, Dr. R. Rossiter.
Hon. Secretary, Mr. B. J. Quinlivan.
Asst. Hon. Secretary, Mr. F. E. Ryan.
Hon. Treasurer, Mr. W. P. Cullinane.
Journal Sub-Editor, Mr. C. Hale.
Committee Members, Mr. E. T. Bailey, Mr. B. Marsh, Mr. T. C. Miller and Dr. L. Snook.

The Executive Officer, Mr. J. A. Roberts, attended the meeting and he was welcomed and introduced to the Branch by the President.

Mr. Roberts spoke briefly on the immediate aims of the Central Office.

The formal business was followed by a buffet tea, after which the retiring President, *Mr. M. Cullity*, delivered his Presidential Address entitled *"Agricultural Services."*

In his address, Mr. M. Cullity advocated the creation of a body to maintain a continuous scrutiny over the field of agriculture. This body would be required to define the problems, to arrange for the appropriate investigation where necessary, and to assist in providing for the results of research to be translated into practical agriculture without undue delay. The body that he proposed would be responsible for examining the whole field of agricultural services with a view to their improvement.

Mr. Cullity said that professional agriculture, which he described as Public Service in Agriculture, is a force aiming at increased productivity and improved standards of living for the farmers. It acts through the three main channels of Education, Extension and Research. These are not completely separate activities, but have close inter-relationships which should be carefully preserved.

The provision of such services by the community is an effort to assist the farmer to acquire the greatest amount of useful knowledge to enable him to produce the community's requirements of food, while achieving a satisfactory level of living for himself.

To obtain the best result, the separate forces should be organised so that they exert their power together. There are some questions which should be answered—

Are existing relationships adequate?

Could some co-ordination of the activities of different organisations improve the whole service?

Is there room for improvement by the closer integration of different aspects of the work within the various bodies participating?

To show the value of effective co-ordination and integration, Mr. Cullity referred to the system based upon the Agricultural Colleges in Scotland, where there is close integration of Extension, Education and Research. There had been considerable co-ordination in Western Australia, but there was room for more. Probably the opportunity for integrating activities of Education, Extension and Research was greatest in Departments of Agriculture.

He stressed also that co-operation between personnel was essential, and pointed to the obligation upon Leaders to ensure that the value of the collective work of Agricultural Services was not reduced because of personal disagreements.

For all of these reasons, he was of the opinion that a Committee comprising representatives of the farmers, agricultural teachers, and representatives of the extension and research bodies, should be appointed to keep a continuous watch over the requirements of agriculture, and the effectiveness of the work being carried out.

At a meeting on the 18th February an 'Open Forum' was held and the four papers reported below were presend.

Mr. M. M. Wallace. "Population changes of pasture pests following insecticide treatments." Mr. Wallace discussed a series of experiments on subterranean clover pastures, using various insecticides to control the red-legged earth mite, and the lucerne flea. After treatments, the insects could be adequately controlled, though numbers rose later in the year, when the herbage was adequate. If insecticides affecting only one of the insects were used, the numbers of the other insect would rise to a level, much higher than on untreated areas. This suggested that the two insects were actually in competition with one another.

Mr. T. Stoneman. "Water Penetration on Saline Soil." Mr. Stoneman described the low infiltration rate seen on bare, salty soils, and the theories advanced to explain this. An infiltration experiment had shown that removal of the top two inches of the soil increased infiltration to the rate seen on adjacent grassed non-saline soil. The top one inch was mainly responsible for the effect, which is probably due to a high concentration of salt in this layer leading to a serious breakdown of physical structure there. Mr. Stoneman discussed these findings in relation to shallow and deep cultivation of saline areas.

Mr. L. Snook. "Fluorine in Livestock Rations." Mr. Snook said that the use of superphosphate as a source of supplementary phosphate for dairying herds in Western Australia had raised the question of fluorosis. Western Australian superphosphates was manufactured from Christmas Island phosphate, which is unusually low in fluorine. Also the use of saturated solutions of superphosphate almost eliminated any fluorine in supplements. However, feeding tests of rock phosphate carried out over four years on cows, and five years on ewes, have shown no ill effects. It has been found that the teeth of animals reared in the south-west of W.A. contain remarkably little fluorine, generally less than 100 p.p.m., which may be below the optimum and normal level quoted as 500 p.p.m. in other places.

Mr. J. H. Silsbury. "Some Possible Uses of Kennedya Species as Pasture Plants." Mr. Silsbury said that the development of this group of perennial legumes was initiated because these indigenous species offer a source of plants, which are adapted to the climate and soils of the country, and in which accessible variability exists. An ecological and distributional survey showed that the species are adapted to different growing periods, and that ecotypes within the species are present. Four species out of the 12 were selected as being possibly suitable for agricultural development. Field trials showed that *K. prostrata* was the most promising species for wheatbelt areas, achieving fair production in the second year of establishment, the forage being of high protein content. Indications that the plant uses moisture from below five feet were found. The utilization of the crop for hay, for controlled grazing in winter and spring,

or for intense grazing in the early autumn period was discussed.

The main business at a meeting held on 11th March was an address by *Professor G. Stephenson on "Planning in Town and Country."*

Professor Stephenson discussed the broader issues involved in town planning. He said that in many countries, interest was increasing in the planning of cities in relation to the surrounding country areas. The balance of city and country populations had changed remarkably since the industrial revolution, and now decentralisation was a popular plan, though one difficult to implement.

FINANCIAL STATEMENT

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE.

Income and Expenditure Account for the Year Ended 31st December, 1954

Expenditure.						*Income.*					
To Council Meetings — Travelling Expenses				£258	0 4	By Subscriptions Received:					
General Meeting Expenses				210	9 0	New South Wales Branch			£477	2 0	
Audit Fee				10	10 0	Victorian Branch			668	14 0	
A.I.A.S. Journal —						South Australian Branch			254	2 0	
Subsidy	£400	0	0			Queensland Branch			262	14 0	
Less Contribution Rural Credits Development Fund — Commonwealth Bank	200	0	0			West Australian Branch			328	2 0	
				200	0 0	A.C.T. Branch			231	3 0	
Rebates on Subscriptions				781	7 3	Tasmanian Branch			72	9 0	
Postage, Typing, Stationery and Sundries				237	4 11						£2,294 6 0
Central Secretariat:						*Note*: Subscriptions in arrears and unpaid at 31st December, 1954, amounted to £1,030/5/-					
Staff Salaries	£512	10	0			Donation					50 0 0
Printing and Stationery	161	16	3			Interest on Commonwealth Bonds					28 12 6
Travelling Expenses	43	3	0			Commonwealth Extension Services Grant (to establish and operate the Central Secretariat			£2,025	0 0	
Office Expenses	145	5	11			*Less* Capital Expenditure (see Balance Sheet)			851	2 5	
				862	15 2						1,173 17 7
Depreciation				17	9 11						
Excess of Income over Expenditure for year ended 31st December, 1954				968	19 6						
				£3,546	16 1						£3,546 16 1

MILNE & BURGESS,

Chartered Accountants (Aust.).

Note: The Income and Expenditure Account and Balance Sheet for the Journal will be published in the September, 1955 issue.

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE.

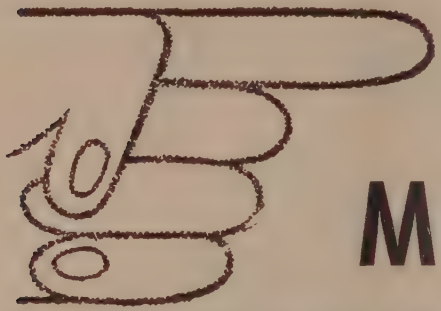
Balance Sheet as at 31st December, 1954.

Capital.					*Fixed Assets (at cost less depreciation).*			
Accumulated Fund Balance, 1st January, 1954 ..	£1,073	5	6		Office Furniture	£11	0	0
Add Commonwealth Extension Services Grant for Establishment of Central Secretariat — Capital Expenditure .	851	2	5		Office Furniture & Equipment—Central Secretariat	834	0	0
Excess of Income over Expenditure for Year Ended, 31st December, 1954 ..	968	19	6					£845 0 0
			£2,893	7 5	*Investment.*			
Suspense Account.					Commonwealth Treasury Bonds — at cost			900 0 0
Commonwealth Extension Services Grant for Printing of Brochure (amount unexpended at 31/12/54)			208	0 0	*Current Assets.*			
Current Liabilities.					Cash on Hand —			
Subscriptions Paid in Advance	18	18	0		Adelaide	£2	2	9
Sundry Creditors	60	15	3		Melbourne	5	0	0
			79	13 3			7	2 9
					Cash at Bank —			
					Adelaide	1,178	17	11
					Melbourne	250	0	0
						1,428	17	11
								1,436 0 8
			£3,181	0 8				£3,181 0 8

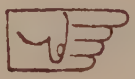
Auditors' Report to Members.

Other than a subsidy paid, no figures relating to the cost of "The Journal of the Australian Institute of Agricultural Science" for the year ended 31st December, 1954, have been included in above accounts. We have examined the above Balance Sheet and have obtained all the information and explanations we have required. We report that, in our opinion, such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Institute, excluding the Journal, as at 31st December, 1954, according to the best of our information and explanations given to us and as shown by the books of the Institute.

MILNE & BURGESS,
Chartered Accountants (Aust.).
Adelaide, March 7, 1955.

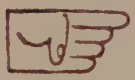


5 groups of MONSANTO AGRICULTURAL CHEMICALS



SELECTIVE HERBICIDES

for the control of weeds in crops and pastures.



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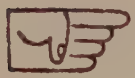
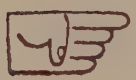


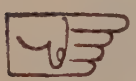
FUNGICIDES

to protect orchard trees, vegetables and tobacco crops from fungal attack.



MITICIDES

to control the mite build-up in orchards.



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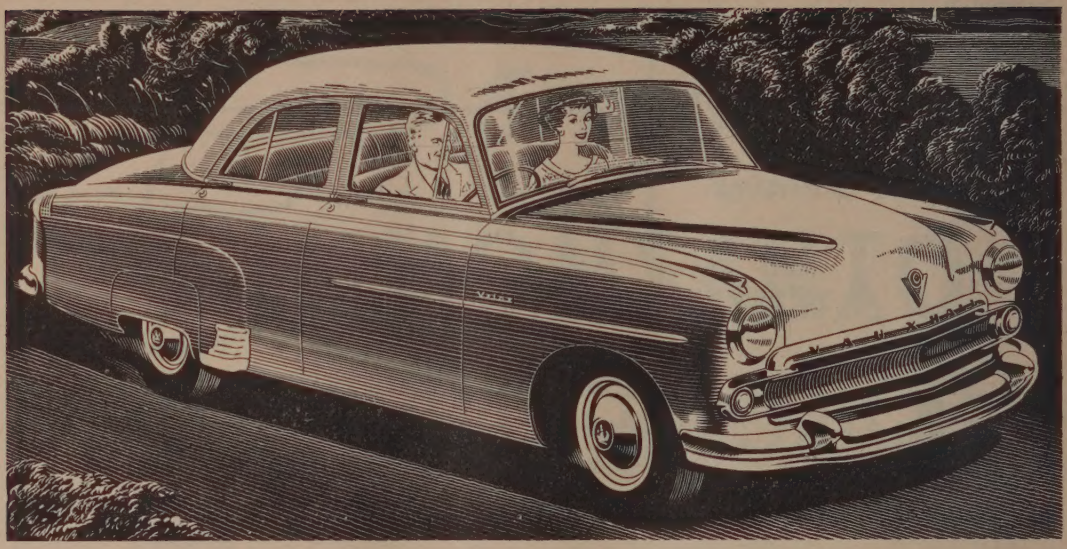

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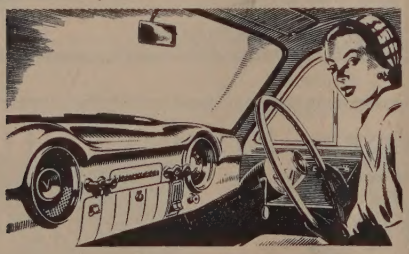

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APPOINTMENTS AVAILABLE

(*See also Page* 86 *for further "Appointments Available"*)

PUBLIC SERVICE OF SOUTH AUSTRALIA.

Applications for the positions set out hereunder will be received by the Public Service Commissioner, 31 Flinders Street, Adelaide, until and including Monday, 4th July, 1955.

Applicants should state full names, address, date of birth, marital status, academic qualifications, practical experience, and give particulars of war service (if any). Copies only of testimonials should be submitted with the application.

The appointees may be required to contribute to the Government Superannuation Fund.

SALARIES QUOTED ARE ACTUAL.

•

Agriculture Department.

CHIEF HORTICULTURIST.

Salary Range: £1,950-£2,150 per annum.

Duties: Administer the Horticultural Branch and supervise its advisory, research and regulatory functions. Supervise the advisory and research services and work associated with the administration of Acts relating to Horticultural matters. The appointee will also be required to supervise fruit export inspection and plant quarantine activities which are carried out on behalf of the Commonwealth Government.

Qualifications: A Degree in Agricultural Science and horticultural and administrative experience are essential.

•

SOIL CONSERVATOR.

Salary Range: £1,950-£2,150 per annum.

Duties: To administer the Soil Conservation Branch and supervise the research and advisory services and work associated with the administration of the Soil Conservation Act.

Qualifications: A Degree in Agricultural Science with experience in soil conservation and administration are essential.

•

CHIEF ADVISER IN ANIMAL HUSBANDRY.

Salary Range: £1,950-£2,150 per annum.

Duties: To administer the Animal Husbandry Branch and supervise its advisory and research services.

Qualifications: A Degree in Veterinary or Agricultural Science; a knowledge of the practices and problems of Australian animal husbandry, and administrative experience are essential.

LIVESTOCK RESEARCH OFFICER (POULTRY), Poultry Experiment Station, Seven Hills, Department of Agriculture, N.S.W.

Salary £1,030 to £1,395, according to qualifications and experience. Progression up to £1,530 assured subject to specified conditions. Duties involve assisting with poultry experiment work on breeding and nutrition. University Degree, preferably B.V.Sc. or B.Sc.(Agr.), required. Apply Public Service Board, 19 O'Connell Street, Sydney, by 1st July.

Notice to Members

•

Members will note the interest shown by Advertisers in our Journal.

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AGRICULTURAL CHEMICALS

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